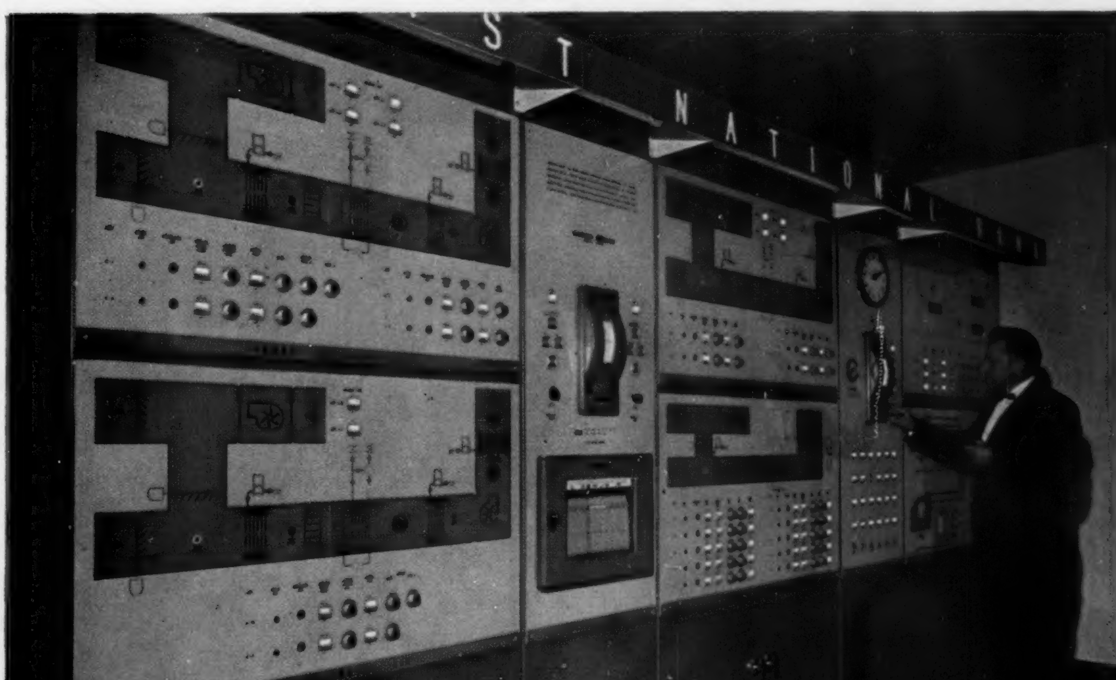
OFFICIAL PUBLICATION

JOURNAL

Heating • Refrigerating • Air Conditioning • Ventilating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS



CENTRALIZED, ONE-MAN SUPERVISION OF AIR CONDITIONING SYSTEMS AT THE MINNEAPOLIS FIRST NATIONAL BANK MONITORS 29 SUPPLY AND 23 EXHAUST SYSTEMS, 2 COMPRESSORS, 25 ELECTRONIC AIR CLEANERS AND 750 HP FOR FANS MOVING 900,000 CFM AND PROVIDES MECHANICAL AND ELECTRICAL CIRCUIT DIAGRAMS (SEE PAGE 46)

NOVEMBER 1960

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VOL. 2 NO. 11

JOURNAL

OFFICIAL PUBLICATION

Formerly Refrigerating Engineering including Air Conditioning, and incorporating the ASHRAE Journal.

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FEATURE

NEWS

DEPARTMENTS

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The ASHRAE does not necessarily agree with statements or opinions advanced in its meetings or printed in its publications.

Comment

MEN OF DESTINY

It may well be that we can all be divided as to extremes, either to be Builder-uppers or Breaker-downers, and sometimes we must stand up and be recognized for the side of which we would be known. Organizations, like individuals, have their essential characters, too.

In any event, we think of this Society as being a noteworthy, perhaps great, institution never in all probability to be perfect or complete but always on its way to truly worthwhile accomplishments; more vital and stronger than any individual, any group or any faction within it. We think members and staff might well have this in mind as a goal not unrelated to their everyday work, activities and planning.

All of this comes to mind because along with those who are trying to build further such a noble institution are a few who would first satisfy their own personal objectives and interests. To put it another way, there are some who would build grandly and some who would give and get what individual members want.

The Show can be run either way, but like many other things, the decision should not be by default or on the basis of intensive action on the part of a noisy or persistent minority.

EARN AND DESERVE

We were assailed the other day by a young Torch-Bearer who felt he had a gift for creating good understandings—something of which we devoutly wish there were more in the world around us.

However, he proposed to establish this higher rapport by seeking publication of certain "creative" statements about the organization by which he was employed. "Are they true? Are they factual?" we asked him. Well, he didn't know, but true or false, real or unreal, they were he felt "constructive" and would create a good impression on behalf of his employer.

It seems to us that the first requirement for favorable reactions is to earn and deserve them which, we submit, has less than nothing to do with the first claiming such perhaps non-existent qualities.

TIME TO THINK ABOUT CHICAGO

With the probability strong that the forthcoming Semiannual Meeting of ASHRAE in Chicago will be our largest, as measured by attending members and guests, and that the accompanying 15th International Heating and Air-Conditioning Exposition will be the largest, too, in point of number of exhibitors and of those attending, it is well to look ahead and plan for February 13-16.

The Program Committee has been even more selective than usual, perhaps, in determining upon papers for inclusion within the well-balanced and diversified technical program. Symposiums will reflect all major patterns of interest. Forums have been chosen deliberately for provocative and controversial subjects.

Under the provisions of the Plan for Consolidation, a change of officers will be made at this Semiannual Meeting and they will be installed at the Banquet rather than at the Welcome Luncheon as has heretofore been customary.

We'll be seeing you there, we hope.

Edward R Searles
Editor

Late news highlights

Dairy Conference To be held at Michigan State University, February 28 and March 1, 1961, The Ninth Annual National Dairy Engineering Conference will concentrate upon automation in dairy operations. Gathered will be speakers from processing plants, equipment manufacturers, and others whose activities relate with quality control devices, computers and similar equipment.

Honoring Willard Established in memory of recently deceased President Willard, of the University of Illinois (see page 57 this issue), the Arthur Cutts Willard Lectureship and Student Grant Fund invites contributions. Contact is University of Illinois Foundation, Room 224, Illini Union, Urbana, Ill.

Engineering-Management There will be an intensified 10 day short course for engineers and managers on the Los Angeles campus of the University of California, January 23-February 2, 1961. Objective is to contribute to the development of engineering and management personnel. Each participant will enter a program tailored to aid in achieving his goal, whether this be improved current job performance or preparation for greater responsibilities. The fee, $450, includes all texts and classroom materials, and certain meals.

Celebrating 75 Representatives of 103 colleges and universities, from 39 states, participated in the 75th anniversary convention sessions of Tau Beta Pi, at Lehigh University, early last month. The program of this national engineering honor society for this occasion included the unveiling of a monument to the late Prof. Edward H. Williams, Jr., of Lehigh, a discussion of science and the engineer by Dr. William F. G. Swann, of the Franklin Institute, and a panel discussion on the professional development of young engineers.

How to cool Sponsored by the Division of Agricultural Sciences, University of California, Bulletin 773 is a 68-page review of Coolers for Fruits and Vegetables. Author is Rene Guillou who co-authored "Highly Marketable Grapes Maintained by Controlled Humidity" in our April 1960 issue.

Evening courses To assist those already working in certain technical jobs or preparing to do so, New York University will provide special evening courses in heating, ventilating, and air conditioning. Registration may be made by mail. Courses are: heating and ventilating ($75), elements of refrigeration ($55), air conditioning ($75), heating and air conditioning design ($45), plumbing theory and code ($45), and design of electrical systems for modern buildings ($45).

OHI Old Timers Annual banquet of the Old Timers' Club of the oil burner industry will be held February 14, 1961, and will be the 20th of that organization. Expansion of the Club's activities is announced coincidentally to match a newer identification as Old Timers' Club of the Heating and Cooling Industry.

Its Zetetics Whether or not Zetetics will be accepted broadly as a term for the science of research, the author of Toward a New Science, Research Professor Emeritus of Electrical Engineering, at the University of Illinois, J. F. Tykociner, has published a new book organizing present knowledge of research as a science. Obtainable from the Office of Publications, 114 Civil Engineering Hall, University of Illinois, Urbana, Ill. $2.00.

Thermoelectricity Compilation of a comprehensive bibliography on thermoelectricity has been completed by the research staff of AMP Incorporated, Harrisburg, Pa. This includes a critical commentary of each of the listed articles. Copies may be obtained upon request.

Cryogenics again Scientists of the Cryogenic Engineering Laboratory, National Bureau of Standards, are working toward the goal of producing a low-power, steady-state magnet with a 100,000 gauss field intensity, the development of which normally would require enormous amounts of power and an elaborate cooling system. One preferred solution, departing from the traditional, would be based upon a low-temperature operation calling for a refrigeration system circulating liquid hydrogen radially between coils at about 100 gpm. The cryogenic approach would permit extraordinary weight and energy savings.

Smoke emission Under study at Michigan State University, as a sponsored research project, are the smoke emission factors from oil heating equipment. The project is under the direction of Prof. Charles Pesterfield, who is also Chairman of the Oil Burner Committee of the Air Pollution Control Association. A complete study of smoke emission and the chemical composition of such smoke as rising from the operation of oil burners is anticipated.

D. E. S. at Newark Authority to confer the degree of Doctor of Engineering Science, in addition to the B.S. and M.S. degrees heretofore offered, has been extended to the Newark College of Engineering by the New Jersey State Board of Education.

Fuel cell potentials Including domestic heating and cooling within the potentials of fuel-cell technology, Project Director Dr. John McCallum of Battelle Memorial Institute, nevertheless foresees a number of inventions, innovations, and breakthroughs which must precede broader application of the electro-chemical devices which converts chemical energy directly into electrical energy. Efficiencies of 75%, as demonstrated in experimental fuel cells, are referred to by Dr. McCallum.

New home for ASM Dedication of a national headquarters for the American Society for Metals, Metals Park, Novelty, Ohio, was effected on September 14, when President Walter Crafts presided and a distinguished audience, of members and guests, was acquainted with an ultra modern structure and its location.

Refrigerated storage Technical Report No. 38 of the Federal Construction Council, 2101 Constitution Avenue, Washington 25, D. C., covers Refrigerated Storage Installations and was prepared by a task group composed of engineers from major Government agencies. Covered are vapor barriers, insulations, interior finishes, and their installation. An analysis of 44 installations within this country are reported. $2.00.

Nema changes Departing from a long established form of porgram for its Annual Meetings and currently switching from Atlantic City to New York, the National Electrical Manufacturers Association will hold its 34th Annual Meeting November 17. Attendance at this meeting will be by invitation and a highlight will be a symposium with the industry's outstanding scientists discussing research and its practical implications to the electrical manufacturing field.

Costly weather Estimating lowered productivity and time lost during hot weather to account for losses of more than $100 per man per year in the average industrial plant, a survey by Engineers, Inc., Newark, N. J., showed an envelope of $70 to $220 lost per man per year. The survey found some correlation between the hot weather and increased number of accidents, to equipment damage and to production rejects. All these factors were reduced significantly when air conditioning was installed. Specifically, with air conditioning, there resulted 9.5% increase in work production, 0.9% decrease in errors, and 2.5% decrease in absenteeism.

New name Now known as the Welded Steel Tube Institute, the trade organization representing more than 20 leading manufacturers of steel tubing was formerly identified as the Formed Steel Tube Institute. Headquarters continue to be maintained in Cleveland, Ohio.

NOTICE TO MEMBERS OF 1961 SEMIANNUAL MEETING

The Semiannual Meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., will convene at Chicago, Ill., at 9:00 a.m., Monday, February 13, 1961.

Continuing through Thursday, February 16, the meeting will include Technical Sessions covering Combustion, Insulation, Refrigeration, Air Conditioning and general subjects. There will be a Domestic Refrigerator Engineering Symposium and others on frozen foods, heating, air conditioning and ventilation. There will be several Forums on immediate industry problems.

New officers will be installed at the Banquet on Tuesday, February 14.

Every member who can do so should plan to attend the Chicago Meeting and the 15th International Heating & Air Conditioning Exposition which will be held coincidentally with it.

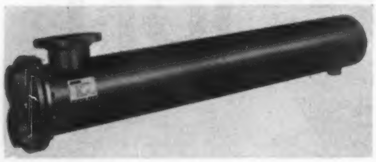
WALTER A. GRANT
President

R. C. CROSS
Executive Secretary

PARTS and PRODUCTS

STEAM CONVERTER

Newest addition to this line of components is the SC steam converter. Used primarily for heating radiation



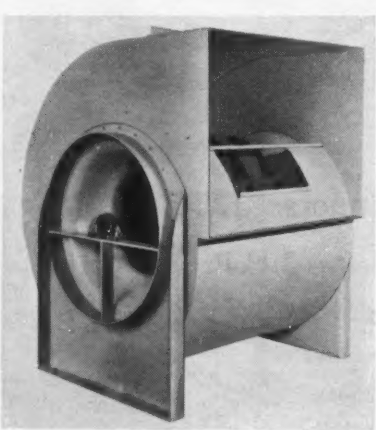
water with steam, the unit is highly efficient for providing heating water for office space in industrial buildings and offers advantages in simplified piping design and reduction of design work. When applied to high buildings, the SC keeps static heads at reasonable levels.

Dunham-Bush, Inc., 179 South St., West Hartford 10, Conn.

BLOWER FANS

Redesign of the company's backward curved line of centrifugal blowers to meet requirements for higher pressure, greater volume, higher velocities and quieter operations has been announced by this manufacturer. Featured are a deepened inlet cone and all-welded, backward curved, spun wheel shrouds, cited as allowing for finer tolerances between stationary and moving parts.

Type BC applications range from air conditioning systems to industrial

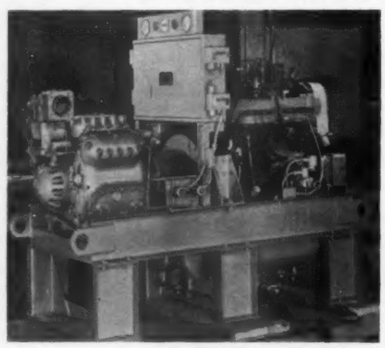


processing, with capacities from 344 to 725,840 cfm offered. Fans can be made available with a variety of accessories and for special applications. Included in the list of accessory items are variable inlet vanes for volume control, inlet guard screens, access doors and housing drains, outlet dampers for volume control, cooling wheels, vibration bases, belt guards and weather hoods. Wheel diam range from 12¼ in., single inlet, single width, to 132½ in., double inlet, double width.

Bayley Blower Company, 1817 S. 66th St., Milwaukee 14, Wisc.

GAS MOTOR POWERED

Air conditioning and refrigeration units powered by natural gas fueled engines are available in three basic models: a package liquid cooler for water cooling systems (shown), a re-



frigeration condensing unit series and an engine compressor unit.

Liquid cooler unit is a complete cooling package, containing compressor, condenser, heat exchanger, centrifugal pumps and evaporator. It is enclosed in a rugged steel frame and is entirely automatic.

Compactly constructed, the refrigeration condensing unit series includes twelve units ranging in capacity from 7½ to 150 ton. Bolts are used in construction rather than welding, to simplify maintenance.

Modulation range of the engine compressor unit is from 1800 to 1200 rpm. Unit's lubrication supply is sufficient for 2000 hr.

Bell & Gossett Company, Morton Grove, Ill.

GAUGE ACCESSORIES

Two newly-designed pressure gauge accessories, a pulsation dampener and a chemical attachment, offer improved performance and easier maintenance where gauges must be protected from damaging effects of pulsating pressures or corrosive chemicals.

Both accessories have a diaphragm (stainless steel or Neoprene) which separates the measured fluid from the gauge measuring element. Space above the diaphragm is filled with a viscous, non-freezing liquid which transmits measured pressure to the gauge element. For pulsation dampening, there is an adjustable restriction in a passage from the diaphragm top to the gauge.

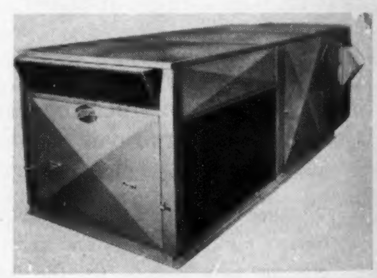
Pulsation dampener has a threaded plug, externally adjustable with a socket head wrench. A tapered slot in the side of this plug varies the opening of the passage to the gauge, regulating the degree of damping for all conditions of flow, viscosity and rate of pressure pulsation. Gauges equipped with the dampener can be used with fluid temperatures between 50 and 100 F without temperature correction. When used at temperatures outside these limits, the gauge will be accurate only at the temperature at which it is calibrated.

Designed to prevent measured fluids from clogging or corroding the gauge spring element, the chemical attachment also can be used for pulsation dampening, having the same basic design of adjustable passage.

United States Gauge Div, American Machine & Metals, Inc., Sellersville, Penna.

PRE-FABRICATED UNIT

Introduction of a new 17½-ton unit to the AtmosPak line of air-cooled, roof-mounted, year-round air conditioning systems has been announced. Other units in the line range from 5 to 35 ton. Duct work is eliminated with this system, for units are equipped



with pre-fabricated supply and return distribution chambers and require no field assembly of any kind. Use of multiples makes possible a broad range of applications. Universal heater section, which is part of the system, may be had with either oil or gas-fired exchangers.

Air-Conditioning, Inc., 88 N. Highland Ave., Ossining, N. Y.

FURNACE LINE

Large volume air deliveries at low sound levels are featured on this line of gas up-flow residential furnaces (Model GUC), and they are designed

to be adapted to cooling applications. Six sizes are included in the line, with ratings of 100,000, 125,000 and 150,000 in both heating and cooling drive. GUC 100 and 125 use large single blowers and GUC 150 has a twin blower assembly.

For summer cooling, up-flow coils that match the furnace units are available in four sizes, providing two, three, four or five ton of cooling. Three-row coil design and continuous fin construction are cited as insuring max moisture removal.

Westinghouse Electric Corporation, Box 2278, Pittsburgh 30, Pa.

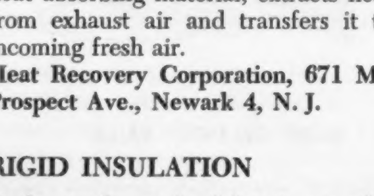
TEMPERATURE CHAMBER

Designed for both moderate production and environmental testing, continuous operation or intermittent use, this two-cu ft unit includes many features found in larger models. A temperature range from −150 to 300 F (±2 F) is afforded by the unit, designated Model A-120-2-HC. Chamber is 24 x 12 x 13½ in. and unit is equipped with fin coil, blower, two two-in. ports and lid with multipane frost-free window. Chamber is mounted on casters for portability.

Cincinnati Sub Zero Products, 3932 Reading Rd., Cincinnati 29, Ohio.

HEAT EXCHANGER

Engineered to fit into the intake and exhaust of a ventilation system, the Rotary-X-Changer is intended to recover heat from contaminated exhaust air or to cool incoming air to air conditioned or refrigerated space. A rotary wheel within the unit, filled with heat absorbing material, extracts heat from exhaust air and transfers it to incoming fresh air.



Heat Recovery Corporation, 671 Mt. Prospect Ave., Newark 4, N. J.

RIGID INSULATION

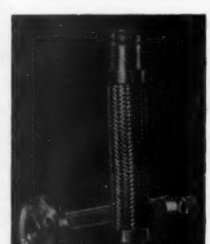
To be used as a load bearing insulation at pipe hanger locations, deeply buried underground lines and other areas where pipe covering may be subject to compression set deformation, Rigid Armaflex, a rigid foamed plastics material, has physical properties similar to Armaflex 22, a flexible foamed plastics pipe covering. Available in nominal ½ and ¾-in. thicknesses for sizes ⅜ in. ID to three in. I.P.S. and furnished in pre-matched half sections three ft long, it was developed to be used in conjunction with the flexible material.

Widely used on liquid cooling and heating, chilled water and other cold lines in plumbing, heating, air conditioning, refrigeration and industrial processing applications, Armaflex can be used from below zero to 220 F and has a low k value of 0.28 at 75 F mean temperature.

Armstrong Cork Company, Insulation Div, Lancaster, Pa.

FLEXIBLE CONNECTORS

Effects of pipeline vibration, misalignment or thermal expansion in pump installations are cited as being absorbed or reduced by flexible pump connectors. Consisting of a short section of corrugated flexible metal tubing, protected against pressure elongation by wire braid, units are furnished with threaded or flanged end connections to fit standard piping sizes and are available from ¼ through 8 in. in bronze and hot-dip galvanized steel and ¼ through 4 in. in Monel.



Materials, lengths and construction are varied to suit the conveyed fluid, pressure, temperature and movement encountered. Pressures up to 1500 psig may be handled, depending on alloy, braid construction and size. Temperatures to 1200 F may be handled in stainless steel, 800 F in Monel and hot-dip galvanized steel and 450 F in bronze.

Allied Metal Hose Company, 3746 Ninth St., Long Island City 1, N. Y.

ALUMINUM DAMPER

Air-tight because of the use of polyvinyl stripping where the blade meets the frame, the Arrow-Foil is an extruded aluminum damper offered with an air-foil double blade. Blade sizes are of any length, five to nine in. wide. Because of the special pin lock-groove design, there is positive blade turning. Other advantages include quiet operation, less friction and less turbulence. Dampers are available either with parallel or opposed action. When closed, the double blade, with the air space in between, acts as an insulator.

Arrow Louver & Damper Corporation, 72 Berry St., Brooklyn 11, N. Y.

FELT SEALING TAPES

Suggested uses of these pressure-sensitive tapes are for sound-deadening, cushioning, insulation, dust and moisture seals. Three types are available: Presstite No. 500, untreated felt with adhesive on one side and an easily removed protective backing; No. 505, asphalt-treated felt with pressure-sensitive adhesive; and No. 508, wax-impregnated felt, chromate treated. This last also protects against corrosion and fungus. Tapes are cited as adhering to almost any clean surface, with no nailing, tacking or stripping necessary.

Presstite Div, American-Marietta Company, 39th and Chouteau Ave., St. Louis 10, Mo.

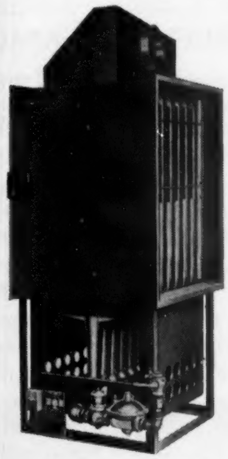
OVERLOAD RELAY

Development of a compact overload relay that compensates for both heat and cold, operating on the same time curve at all temperatures from −20 to 65 F, has been announced by this manufacturer. Compensation is automatic, so no field adjustment is needed.

Working and compensating bi-metal, identical in size and construction, are joined by a coupling bar. As the ambient temperature rises above or falls below 72 F, the compensating bi-metal operates through the bar to move the working bi-metal in order to maintain its distance from the trip arm.

Available with all magnetic starters in Nema sizes zero through five, the ambient compensated overload relay is supplied in ratings from 25 to 300 amp, continuous current. Normally supplied with manual reset, relays can be equipped with a change-over lever that provides manual or automatic reset, as required. Suggested application is for roof-top air conditioners and other outdoor installations subject to wide seasonal or daily changes in ambient temperatures and for in-

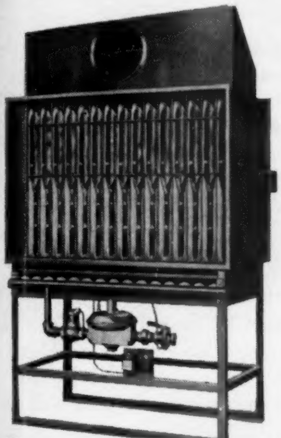
STAINLESS STEEL HEAT EXCHANGERS



SED-S
Duct Furnace, 45,000 to 675,000 BTU Imput—End Surface

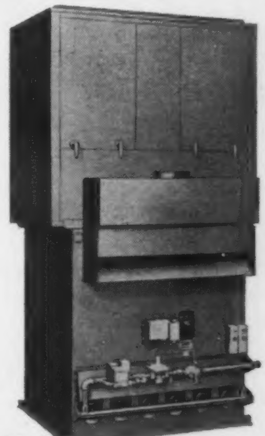
SEU-V
Vertical Unit Heater, 70,000 to 245,000 BTU Imput

SED-VF
UP Vertical Duct Furnace, 70,00 to 280,000 BTU

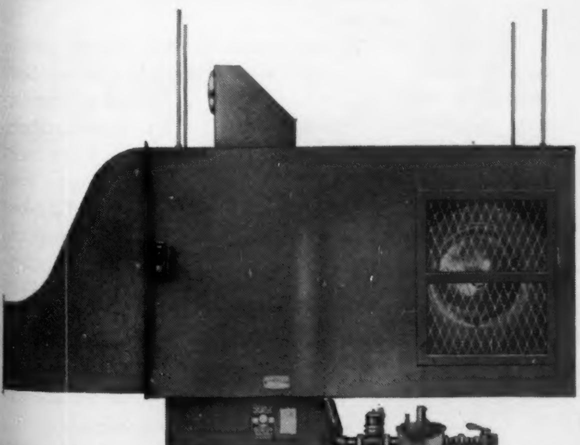


SED-E
Duct Furnace, 45,000 to 675,000 BTU Imput—Side Surface

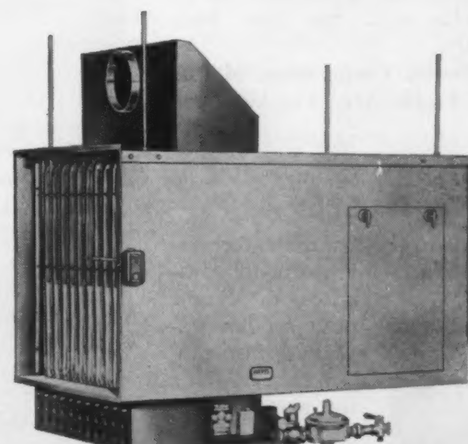
SEC
Forced Air Furnace, 70,000 to 245,000 BTU Imput



SED-CF
Counter Flow Duct Furnace, 70,000 to 280,000 BTU Imput



SEU
Suspended Unit Heater, 80,000 to 480,000 BTU Imput



SES
Suspended Forced Air Furnace, 80,000 to 480,000 BTU Imput

HAYES FURNACE MFG. & SUPPLY CO.

3233 SOUTH LA CIENEGA BOULEVARD, LOS ANGELES 16, CALIFORNIA

Telephone UPton 0-3734

door control installations located near boilers, furnaces, heating units or refrigeration equipment.
Arrow-Hart & Hegeman Electric Company, Industrial Control Div, 103 Hawthorne St., Hartford 6, Conn.

IMPROVED THERMOMETERS

Featuring anti-parallax face design cited as eliminating errors when read from any angle and external pointer calibration, Bimet industrial thermometers are presented in new and improved designs. All units are sealed hermetically and dust, moisture and fume-proof. Silicone dampening stabilizes pointers against vibration.

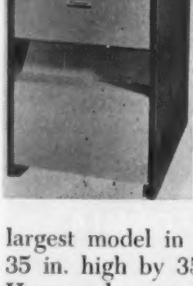
Moeller Instrument Company, Inc., 132nd St. & 89th Ave., Richmond Hill 18, N. Y.

VENTILATING FANS

Heavy duty ventilating and mechanical draft fans designed for the marine industry are available in three basic types: centrifugal, vane axial and centrifugal airfoil mechanical draft fans. Centrifugal fan capacities range from 250 to 10,000 cfm, with fan sizes from 2.5 to 100. Standard units employ direct drive from motors, with belt drives also available. Motor sizes range from 1/20 to five hp. Axial fan capacities are from 1000 to 40,000 cfm, with fan sizes ranging from 10 to 400 and motor sizes from ½ to 20 hp. Capacities of airfoil mechanical draft fans go as high as 1,097,940 cfm, with fan sizes from 24½ to 80¾.
Chicago Blower Corporation, Marine Div, 9867 Pacific Ave., Franklin Park Illinois.

CAST IRON BOILERS

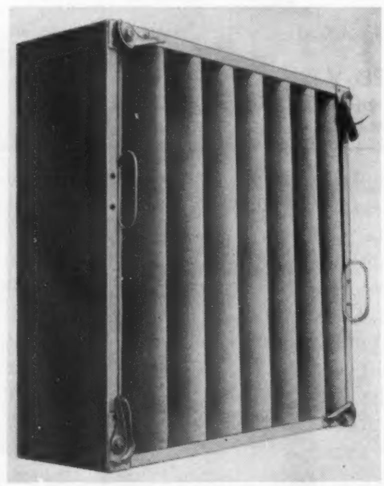
Companions to the manufacturer's recently introduced "Professional" furnaces, these new units for hot water and steam systems are available for natural, mixed, manufactured and LP gases. Capacities range from 72,000 to 224,000 Btu/hr output. All units are compact, the largest model in the line being only 35 in. high by 35 wide by 32 deep. Heavy glass wool insulation keeps heat within the boiler. Additional features include: built-in horizontal to vertical flue collector and draft hood; silent, stable-flame slotted burners; high-efficiency internal design with staggered flue-gas travel; 100% safety pilot shut-off; and full complement of gauges and controls.



Stewart-Warner Corporation, Heating and Air Conditioning Div, Lebanon, Indiana.

AIR FILTER

Foamat filter, a new unit air filter utilizing a single sheet of synthetic plastics material, has been added to this line. Sponge-like in appearance,



the filter breaks an air stream into small jets. Dust and dirt cannot follow and are trapped in the cells. Designed as a permanent filter, the unit will not pack, settle, separate or develop thin spots. Media replacement is eliminated.

Media is pleated into a holding frame in order to present the greatest possible area for dirt storage and is interchangeable with other pleated-media filters. Foamat is resistant to moisture and vermin and is treated chemically for flame resistance. Available in three models which permit capacities as high as 1800 cfm per cell, the filter is designed to handle velocities to 450 fpm. Non-corrosive aluminum cells are standard.
American Air Filter Company, Inc., 215 Central Ave., Louisville 8, Ky.

CONDENSING UNIT

Shipped completely assembled, piped, wired and with all safety devices installed (including high-low shut-off) to reduce field assembly time to a minimum, CA 301-303 air-cooled condensing units are operated and tested at the factory. Capacity is 36,000 Btu/hr, using a three-hp compressor and 1/3-hp centrifugal blower. Single (CA-301) or three-phase (CA-303) wiring is available.
Texas Products Manufacturing Company, Waco, Texas.

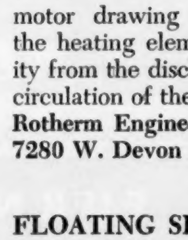
COUNTERFLOW FURNACES

Compact design is featured on a new line of gas-fired counterflow furnaces now being manufactured in 60,000, 80,000, 100,000 and 120,000-Btu/hr sizes. Models rated at 140,000 and 160,000 Btu/hr will be available in the near future. Cabinets on the first two units are 12 in. wide, 25½ in. deep and 59 in. high; the latter two units are the same height and depth but are 20 in. wide. Flue connections are four in. diam on the 60,000 and 80,000 Btu/hr models and five in. on the 100,000 and 120,000. Other features on 700 Series furnaces include a high efficiency sectional heat exchanger, foil-faced glass fiber cabinet liners, removable permanent-type filters and blowers sized to meet air moving requirements for air conditioning as well as heating.
Armstrong Furnace Company, 851 W. Third Ave., Columbus 12, Ohio.

ROOM HUMIDIFIER

Combining a water container with an electrical heating element suspended above the water level, this room-type humidifier is designed to provide instant controlled 85 to 90% relative humidity at approximately 5 F over room temperature, equalized in the room without condensation. A spinner attached to an electric motor lifts drops of water centrifugally from the container and sprays them against the heating element, effecting vaporization.

When steam is introduced into a room at approximately room temperature, there is no condensation, since it is only when steam contacts air at a much lower temperature that condensation is visible as moisture. A fan attached to the motor drawing circulating air over the heating element picks up humidity from the discharged water, forcing circulation of the vapor into the room.



Rotherm Engineering Company, Inc., 7280 W. Devon Ave., Chicago 31, Ill.

FLOATING SKIMMER

Cited as removing boiler water impurities at point of greatest accumulation, the Surf-Blow floating skimmer

automatically and continuously skims off solids from the steam release zone. Unit is of all-stainless steel construction and easy to install. Operation is completely automatic, requiring only setting of the continuous blowdown valve.
Boiler Specialties Corporation, 600 W. 9th Ave., Gary, Ind.

TEMPERING VALVE

Adjustable from 120 to 160 F, this valve utilizes a thermostatic power element to assure positive operation. No. 300 mixes hot water with cold water to produce properly controlled mixed water. Two of the connections can be used with either ½-in. iron pipe or ½-in. copper tubing, making it unnecessary to stock two different models and providing flexibility in installation.

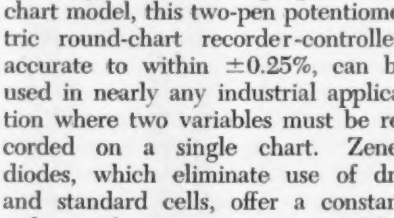
Dole Valve Company, 6201 Oakton St., Morton Grove, Ill.

ROUND-CHART RECORDER

An adaptation of a single-pen round chart model, this two-pen potentiometric round-chart recorder-controller, accurate to within ±0.25%, can be used in nearly any industrial application where two variables must be recorded on a single chart. Zener diodes, which eliminate use of dry and standard cells, offer a constant voltage reference accurate to ±0.05%. Temperature coefficient is 0.001±/C. Min scale spans are one millivolt dc. Available response times are 4, 10 and 24 sec full scale. Concentric scale length is 27.5 in. Pen speeds are 4, 10 and 24 sec full scale and chart speeds are 1, 8, 12 or 24 hr or seven days.
General Electric Company, Schenectady 5, N. Y.

OVERHEAD CONDITIONER

Type 30 Remotaire, a fan-coil overhead air conditioning unit, is now

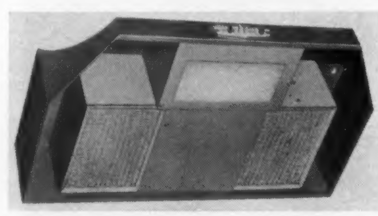


offered in a decorative cabinet, thermally and acoustically insulated, measuring only 10¾ in. deep and designed specifically for exposed overhead installation.

Separate top panel of the cabinet unit is a ceiling mounting plate, to which the basic unit is secured at four points. The "wrap-around" enclosure, with integral front, side and bottom panels, fits into place on the mounting plate and is secured to the back panel after piping and electrical connections have been made. Four capacity sizes are available.
American Radiator & Standard Sanitary Corporation, Plumbing & Heating Div, 40 W. 40th St., New York 18, N. Y.

DUCT-FREE RANGE HOOD

Twin air filter intakes are located directly over range burners for air cleaning efficiency, with a centrally located exhaust fan to draw grease-laden hot air and cooking odors through the intakes and into triple filter elements.



Forming the elements are replaceable layers of heavy-duty aluminum mesh, spun glass fiber and fine granules of activated charcoal. Clean air is returned to the room through vents in the upper slope of the hood.
Philip Carey Manufacturing Company, Middletown, Ohio.

INSULATING MATERIAL

Results of tests conducted on use of Lockfoam as an insulating material in refrigerated trucks have shown that −10 F with an outside temperature of 100 F is assured, with −25 F under normal operating conditions more likely.

Lockfoam, a urethane plastics foam with K factor of 0.13, can be poured into place as a liquid mixture. Subsequent foaming, as chemical reaction proceeds in the mixture, expands the plastics so that it entirely fills the cavity or void with a low density homogeneous solid.
Nopco Chemical Company, North Arlington, N. J.

14-DAY TIME SWITCH

Used to turn a motor on one week and off the next, this time switch is designed specifically to allow pumps, motors or other equipment to rest, in installations using two sets of units to be worked on an alternating schedule. Designated Model 14D1197, the unit is a single-pole, double-throw switch.
Tork Time Controls, Inc., Mount Vernon, N. Y.

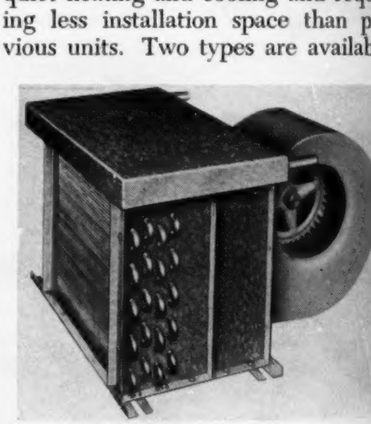
DEFROST CONTROL

For use on refrigerators, freezers and refrigerator-freezer combinations, the F19 plunger-operated automatic defrost control initiates a defrost cycle after mechanically counting a predetermined number of door openings. Frequency can be supplied for 15, 30 or 60 plunger operations (door openings) per defrost.

Defrost is terminated automatically by the temperature power element as soon as the evaporator temperature rises to the precalibrated termination temperature on the control. Termination temperatures between 40 and 60 F can be provided with a min differential of 20 F available.
Ranco Inc., 601 W. Fifth Ave., Columbus 1, Ohio.

LARGE CAPACITY UNITS

By combining rounded and square lines, this manufacturer has introduced a newly designed large capacity Seasonmaker air conditioner for quiet heating and cooling and requiring less installation space than previous units. Two types are available,



a ceiling unit for suspended installation and a hideaway model for installation above a furred ceiling or other concealed location. Nominal capacities are from two to ten ton. Ceiling models have direct or belt drive motors.

Designed for use with a hot or chilled central water supply system, they are also available for refrigerant operation. Three-speed operation, a double drain pan with closed cell insulation for protection against sweating and an auxiliary drain pan to catch condensation from the control or shut-off valve are featured.
McQuay Inc., 1600 Broadway St. N.E., Minneapolis 13, Minn.

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Field laboratory for heating studies

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Current energy demands of the United States for power, processing, and heat average approximately 100,000 billion Btu per day, 30% of which is required for space heating. This proportion is likely to remain constant for the next century. But total energy requirements of the United States and the rest of the world are rapidly increasing both because of booming population growth and the impact of rapid technological changes on our standards of living. This expanded demand has resulted in marked increases in the costs of oil and gas during the past three decades; yet, an increase in the efficiency of conversion has resulted in reduction in the cost of electricity. All of these fuels are now economically feasible for space heating under some conditions. Nevertheless, the cost of all forms of space heating have risen, and the consuming public has become more conscious of the need for conserving space heating energy through adaptation of properly engineered heating systems coupled with thermally efficient structures.

The past three decades have seen calculation of heating loads progress from rule-of-thumb procedures used in the 1920's when fuels were cheap and space heating comfort demands not rigid, to the present time when the public demands close control of comfort conditions and engineering provides proper analytical procedures for load calculations and system design. Accurate laboratory tests for determining thermal and mass transfer characteristics of building materials now are used routinely.

But, despite these advances, many gaps remain in our knowledge of design and functioning of heating systems when applied to structures. Individual thermal conductivities of materials used in wall sections are known, but effects of framing members and other field installation variables are not dupli-

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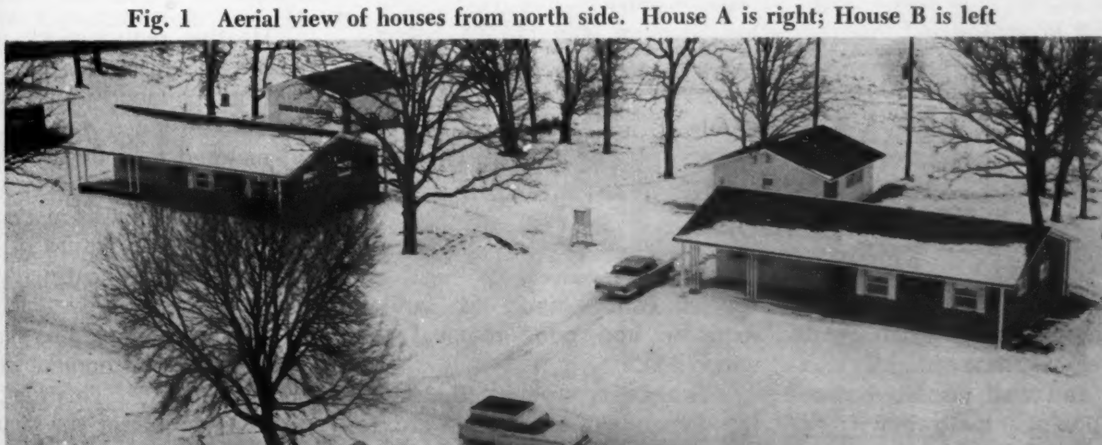
Fig. 1 Aerial view of houses from north side. House A is right; House B is left



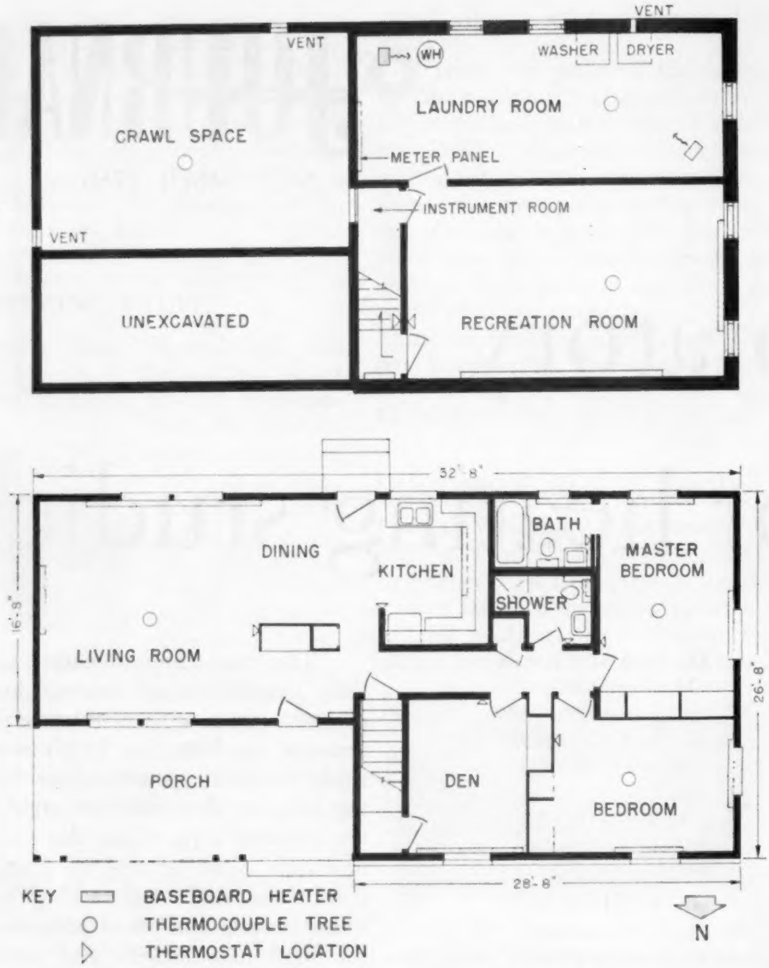
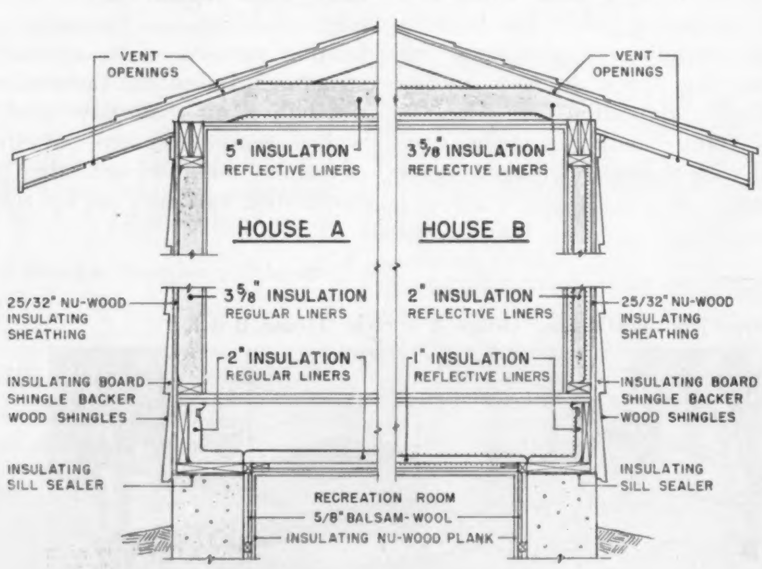


Fig. 2 Plan of first floor and basement showing location of baseboard heating units, thermostats, and thermocouple "trees"

Fig. 3 Cross section showing construction details and ceiling, wall and floor insulation in each house



cated in laboratory tests. Infiltration assumptions are approximate at best. For instance, tightly constructed and well insulated structures, in which infiltration is reduced to a minimum, may require special consideration as far as moisture and odor removal are concerned.

It appears probable that heating demands of a structure are, to an appreciable extent, dictated by ventilation needs and that in tight structures, either artificial ventilation or some internal means of moisture and odor removal may be required. The actual structure to be heated either rests upon or is sunk into a mass of earth of high heat capacity and relatively high thermal conductivity.

The structure to be heated is subjected periodically to a high intensity solar radiation field and a portion of this energy is absorbed on the outside surface of the structure and a portion is transmitted through fenestration to the interior. The outside of the structure is subjected to varying temperatures, varying wind conditions, rainfall and snowfall and solar radiation, and the inside to a variety of unscheduled heat and moisture gains. It is designed and heated that it may provide comfortable living conditions for people who live, work, and play inside; yet, we are not always certain of the effects of these living habits upon heating demands of the structure.

In recognition of these gaps in our technical information, two test houses were constructed to provide field laboratories in which answers to a number of these questions could be obtained. These houses were provided with simulated living loads under accurate control and were fully instrumented to provide complete information on operating characteristics. A continuous record of the external environment was provided through a recording of weather conditions, including solar radiation. Soil analyses were made adjacent to the structures, and the earth's temperature variations recorded through a thermocouple well and adjacent to foundation wall.

Heating requirements of each room of the structures were monitored independently with separate electric resistance heaters zoned and metered to define the heating requirements for various areas. In short, an attempt was made to provide a complete picture of the interplay of various heating demands and heating losses to which a structure is subjected when placed in the transient environment in which it actually exists. This first article describes details of the structures, instrumentation, operating condi-

tion for the first winter's tests, and test objectives. Future articles will discuss the results obtained.

FIELD LABORATORIES AND THEIR ENVIRONMENT

Two test houses were constructed on adjacent 120 x 135 ft north-south oriented lots on the edge of Stillwater, Minn., 18 mi east of St. Paul. They are identical except for differences in insulation. Each was constructed with a system of panel wall components[1] with approximately 1100 sq ft of living area. Fig. 1 shows an aerial photograph of the houses and Fig. 2, a first floor and basement floor plan. The houses are north oriented. Both have approximately the same solar radiation exposure on the east, south, and west; shadow pattern photographs were taken at different times of the year to determine this point.

Table I presents a summary of sq footage of floor space, calculated design heat loss in Btu per hr, and wattage of electric heating elements installed in each room. All rooms on the first floor and the recreation rooms are heated by convection type baseboard electric units. Two 2000-watt blower type electric heating units were placed in the laundry areas of each house. During the early part of the first winter, line voltage thermostats were used in 7 different zones in each house. Later, two piece, low-voltage thermostats were installed in order to provide more precise temperature control needed in these comparisons. These units cycle the heating elements approximately 10 times per hr and provide temperature control within approximately ± 0.25 F.

House Construction and Heat Demand Calculations — Both test houses are identical with the exception of differences in type and thickness of wood fiber blanket insulation as shown in Table II. Over-all heat transmission coefficients as determined by calculation (corrected for framing heat loss) and guarded hot box test are included. Basement recreation room exterior walls in each house were

[1] Lu-Re-Co system of construction consists of preassembled modular 4 x 8 ft exterior wall, window and door panels (2 x 4 studs are 24 in. on center) and roof trusses paced 24 in. on center. Conventional exterior and interior finish materials are used to complete the house.

TABLE I

SUMMARY OF HEAT LOSS CALCULATIONS OF FIRST FLOOR AND BASEMENT ROOMS FOR ONE-HALF AND ONE AIR CHANGES PER HR AND THE INSTALLED HEATER CAPACITY FOR EACH ROOM

Room	Area Sq Ft	Calculated Btuh Heat Loss[a] House "A" Air Change 1	House "A" Air Change ½	House "B" Air Change 1	House "B" Air Change ½	Installed Heater Capacity Watts
Living Room[b]	448	16,498	13,552	17,071	14,126	4,400
Kitchen	106	2,992	2,293	3,112	2,413	800
Master Bedroom	160	5,294	4,249	5,529	4,485	1,600
Master Bath	42	1,386	1,113	1,451	1,178	600
NW Bedroom	150	5,045	4,059	5,321	4,335	1,600
Den	142	4,734	3,553	5,010	3,829	1,250
Shower	36	683	447	710	474	600
First Floor Sub Total[a]	1,084	36,633	29,266	38,204	30,840	10,850 W. 37,031 Btu
Stair well[c]	40	695	695	695	695	1,000
Recreation Room[c]	329	546	546	570	570	3,750
Laundry[c]	288	2,072	2,072	2,140	2,140	4,000
Basement Sub Total[c]	657	3,313	3,313	3,405	3,405	8,750
Total House	1,741	39,946	32,579	41,609	34,245	19,600 W. 66,895 Btu

[a] Calculation based on double glazed windows and storm doors. For triple glazed windows, subtract 3419 Btu from total first floor heat loss.
[b] Includes hall — 68 sq ft
[c] Basement heat loss calculated at ⅛ air change per hr and 50 F average inside air temperature

insulated with ⅝-in. blanket between 2 x 2 in. furring and ½-in. insulating plank interior finish. The exterior walls in both laundry rooms were uninsulated.

Wall panels were constructed in the shop with 25/32-in. insulating board sheathing, 4 x 8 ft applied to 2 x 4 in. studs, 24 in. on center. Sheathing overlapped on panels ¾-in. at sides and bottom when panels were erected. A strip of sheathing about 12 in. in width was applied to the base of the wall to cover joists and sill plate. Exterior finish on east, west and south walls is insulating board shingle backer and prestained cedar shingles with 12 in. exposure.

Shingles on House A are buff color and on House B, light green, but laboratory tests, to determine equilibrium temperatures when exposed to sunlight, indicate practically no difference in solar absorption between the two colors. North wall of the two bedrooms is red face brick veneer and the two walls of the open porch are faced with ¼-in. hardboard panels, painted.

Between the masonry wall and sill plate, a wood fiber sill sealer blanket insulation was used. Joists are 2 x 10 in., spaced 16 in. between centers. The subfloor is ⅝-in. plywood with vinyl tile in the entrance hall, kitchen, bathroom, and shower room and ¾-in. oak in living room, dining room, and three bedrooms. After wall insulation was installed, ½-in. gypsum wallboard interior finish was applied.

Roof construction was ½-in. plywood on roof trusses placed 24 in. on center. There is a roof overhang of 24 in. from the wall and 7 screened openings in each of the

TABLE II

SCHEDULE OF INSULATION USED IN EACH HOUSE WITH CALCULATED AND HOT BOX TEST "U" VALUES.

House	Construction	Balsam-Wool Blanket Insulation Thickness	Liners	"U" Value Calc.[a]	"U" Value Hot Box Test
A	Ceiling	5 in.	Reflective	.049	.046
	Walls	3⅝ in.	Regular	.062	.057
	Floor	2 in.	Regular	.078	.082
B	Ceiling	3⅝ in.	Reflective	.060	.056
	Walls	2 in.	Reflective	.062	.066
	Floor	1 in.	Reflective	.063	.071

[a] Calculations corrected for heat loss through framing members (10% for ceiling and floor joists, 15% for wall studs, plates, and headers).

Fig. 4 Cone heaters and relay in kitchen simulating occupancy. Dishwasher operates 50 min daily at 7 p.m.

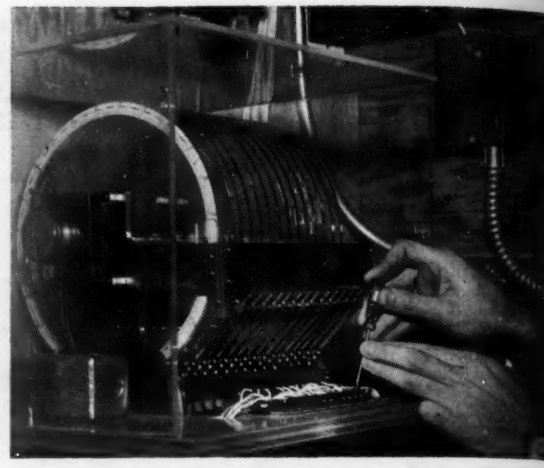


Fig. 5 Programmer enclosed in plastics case located in laundry room which operated appliances and heaters simulating family of four in each house

north and south soffits which provide a total of 203 sq in. of unrestricted opening between the insulation and roof sheathing.

These are provided with covers in order that varying amounts of ventilation can be achieved. East and west gable walls have screened vents with a total free area of 318 sq in. House A is finished with dark brown asphalt roof shingles and House B, with dark green shingles. Again, solar absorption studies indicate very little difference between these colors. After the ceiling insulation was installed, 1 x 4 in. stripping was nailed to the bottom of trusses, 16 in. on center, as a base for ⅜-in. gypsum wallboard interior ceiling finish.

All windows were weatherstripped wood sash with welded double glass. A removable third pane was installed from the exterior with clips. Window and door areas were approximately 15% of gross wall area. Fig. 3 presents a cross section drawing of the construction and insulation used in both houses. The living-dining room and three bedrooms were furnished with major pieces of furniture to occupy space and provide heat storage capacity.

Simulated Occupancy — Demands made upon a heating system are dependent to an appreciable extent upon living habits of the occupants of the space. For this reason, it is difficult to arrive at rational conclusions from field data. It was, therefore, decided that a controlled, simulated occupancy would be defined and installed in order to provide heat and moisture supplements normally added by occupants.

A family of four consisting of two males, both old enough to be considered adults, one adult female, and one child was postulated and heat and moisture gains to the space from these occupants based upon data available in the 1960 ASHRAE GUIDE. It was assumed that the family slept 8 hr in the house and averaged an additional 7 hr of more active life in the living space. Simulated loads, as shown in Table III, were actually distributed over a longer period of the day. Total heat supplied by the occupants was provided through electrical cone heating elements and a proportion of this heat translated to a moisture load by operation of a humidifier in which sensible to latent heat was translated by absorption of heat from the air.

Operation of refrigerator, range, freezer, television set, lights and miscellaneous electrical appliances were also simulated through the operation of electrical cone heaters of appropriate size. However, the electric dishwasher, water heater, shower bath, clothes washer and clothes dryer were actually operated with cycling controlled by a programmer.

Table IV presents a summary of simulated utility loads for this family of four persons as selected for these tests. The first column of this table shows the simulated or actual appliance load, and column 2 shows the period of use per day. Column 3 shows the actual connected load of the unit and column 4, the kilowatt hr per day for the actual or simulated appliance. Column 5 provides explanatory comments on the basis for simulation. References at the bottom of the table indicate the source material upon which these assumptions were based.

Fig. 4 shows one of the simulated heat producing units located in the kitchen of the residence. This unit is composed of two cone heaters covered with protective hardware cloth and equipped with a relay controlled by the programmer, which also controls appliances. In this case, one of the heaters supplies the heat for lights and miscellaneous appliances and

TABLE III
HEAT SIMULATION FOR OCCUPANCY

Location of Simulator	Period of Operation	Total Heater Operation Hr Per Day	Connected Load kw hr	Heat Simulation Btu Per Day Sensible	Latent	Total
Living Room	8 a.m.-11 p.m.	15	.150	5759	1920	7679
Kitchen	8 a.m.-11 p.m.	15	.100	3840	1280	5120
Master Bedroom	11 p.m.- 7 a.m.	8	.015	3072	1024	4096
Bedroom	11 p.m.- 7 a.m.	8	.100	2048	682	2730
Den	11 p.m.- 7 a.m.	8	.075	1536	512	2048
				Total Heat Input, Btu/Day		21,673

were measured in the living room,

the other supplies the heat equivalent of the occupants while in the kitchen.

The heart of the load simulation equipment was the programmer shown in Fig. 5. This consists of 14 plastic cams with one cam representative of each activity. This was equipped with a 24-hr clock and the cams tripped microswitches which, in turn, operate the relays to power individual simulating heaters or actual appliances.

Fig. 6 Central meter panel on east wall of laundry room has 9 individual meters and 2 demand meters

INSTRUMENTATION

Measurement of heating demands and inside and outside environment were provided by (a) an electrical power input measuring system, (b) a temperature measuring system, (c) a moisture measuring system, and (d) an external environment measuring system. Each will be discussed in turn.

Electrical Energy Input – Electrical energy consumption was recorded in each house by nine individual room meters and by two demand meters. The living room, kitchen, northwest bedroom, southwest bedroom, den, bath and shower on the first floor were metered individually and, in addition, meters were provided for basement laundry room and basement recreation room (including stair well). All individual room meters were calibrated to an accuracy of ±0.01%. Fig. 6 shows the location of individual room meters, demand meters, and electric clock. Not shown is camera equipment located in each house which photographed the meter panel board at 12 midnight each day. A timer was set to operate flood lights and through a 30-second delay bimetal tube, the cameras recorded meter readings. During daily inspection of the houses, camera equipment was manually operated and reset for the following midnight photograph.

Temperature Measuring System – A total of 303 copper-constantan thermocouples were used to define temperatures inside and outside houses. Of these, 78 were recorded automatically every 24 min and 145 were read manually each week and were controlled by selector switches. An additional 80 thermocouples, installed to determine specific conditions, were read periodically when information was needed. All continuous recordings were made by means of two recording potentiometers and the manual readings, by means of a portable potentiometer connected to a manually actuated stepping switch.

Room temperature gradients

TABLE IV
UTILITY LOAD SIMULATION FOR FAMILY OF FOUR

Simulation	Total Use Per Day	Connected Load kw	Total kw hr Consumption Per Day	Basis for Simulation
Actual Operations:				
Washer	50 min	.30	.25	7 complete wash cycles per week of 8# canvas cloths washed each cycle.[2, 5]
Dryer	55 min	4.24	3.90	7 complete drying cycles per week of 55 min per cycle. 8# wet canvas cloths taken from washer dried each cycle.[4, 5]
Dishwasher	50 min	1.02	.85	Average daily use estimated at one load per day.[3, 4, 5]
Water Heater	Automatic	2.60	14.16	Operates automatically to supply approximately 60 gal of 150 F water daily (37 gal simulating baths, 4 showers per day, lavatory use and losses; 7 gal for dishwasher; 16 gal for clothes washer).[1, 2, 3, 4, 5]
Simulated Operation:				
Refrigerator	12 hr	.10	1.20	Total daily kw hr consumption. Based on 50% operation and equals average monthly consumption.[3, 4]
Freezer	Continuous	.25	1.80	Total daily kw hr consumption equal to 1/4 hp freezer operating 1/3 of time and equals average monthly consumption.[2, 3, 4]
Range	100 min	2.00	3.40	Total daily kw hr consumption for 100-min operation equal to average monthly use for large cities.[2, 3, 4]
Television	6 hr	.15	.75	Total daily kw hr consumption equals 6 hrs average daily use.[4]
Lights & Misc	Continuous	.14	3.36	Total daily kw hr consumption equals average monthly consumption for misc. appliances, (e.g., toaster, mixer, radio, clock, etc.) and lighting.[4]

[1] ASHAE GUIDE 1959, Chapter 56
[2] Association of Edison Illuminating Companies, "Report of Load Research Committee 1957-1958", April 1959
[3] Association of Edison Illuminating Companies, "Report of the Residential and Rural Loads Subcommittee", June 1959
[4] Potomac Electric Power Company, "Elements of Load", April 1959
[5] Data on manufacturers' published figures and experience of sales personnel submitted by Minnesota Power & Light Company

were measured in the living room, southwest and northwest bedrooms, at the floor, three and 60 in. above the floor, three in. below the ceiling and at ceiling surface. In addition, recording resistance thermometers with a nickel bulb located near room thermostats provided continuous strip charts of room air temperatures in each house. All air thermocouples were shielded from radiation effects by means of concentric foil covered rings which permitted free air circulation but eliminated warm and cold radiation effects from window and wall surfaces.

Wall, ceiling and floor surface temperatures were measured at 22 locations. In addition, the temperature gradients through the north and south walls were measured at both the 60 in. level and across plate. Temperature gradients were also measured through the floor and ceiling constructions, both above and below the thermocouple "trees" provided to measure room air temperatures. Both attic and crawl space air temperatures and surface temperatures were measured.

Ground temperatures are measured in the basement 2 ft, 1 ft and 4 in. below the surface as well as on the surface of the slab. Exterior block wall temperature was taken at 6 in., 2 ft, 4 ft and 6 ft depths outside the recreation room on the north and west walls and outside the laundry room on the west and south walls. In addition, soil temperature measurements were taken to a depth of 10 ft at a point 20 ft west of House B and 65 ft east of House A. These temperatures were recorded at the surface and at 1, 2, 3, 4, 5, 6, 8 and 10 ft depths. Complete soil analyses were made at the time thermocouples were installed.

Fig. 7 Instrument room in basement contains 2 recording potentiometers and selector switches for reading temperatures with portable potentiometer

Fig. 7 shows the instrument room located in the basement and provided as a central point for locating potentiometers and automatic selector switches for temperature programming equipment.

Moisture Measuring System—Continuous readings were made of relative humidity in the living spaces of both houses by two recording hygrometers. Relative humidities were checked weekly with a sling psychrometer in all rooms including attic and crawl spaces. In addition, periodic moisture measurements were made in the wall plates below the kitchen sink, shower room, northwest bedroom, and in the crawl space in the plate located above the concrete block. Moisture probes were permanently imbedded in plates at all measuring points and a Delmhorst moisture meter was used to record moisture contents.

External Weather Measuring System — A U.S. Weather Bureau type instrument shelter[1] was located midway between Houses A and B and contained a resistance type thermometer for air temperature measurements taken once every 2½ min. In addition, a weather instrumentation mast was located approximately 100 ft south of both houses to provide records taken at a 30 ft elevation of wind speed, wind direction and solar radiation. The solar radiation was measured by an Eppley 10 junction pyrheliometer connected to a millivolt recorder. Weather mast and air temperature instrument shelter are shown in Fig. 8.

OPERATION PROCEDURES

Although it was recognized that there was some merit in operating both houses under constant conditions throughout the winter, it was felt that it was more desirable to explore various operating combinations so that a wider variety of data might be obtained. For this reason, a varying schedule of operation was followed and for the period from October 31 to June 1, the houses were operated under conditions for full load simulation 37% of the time; under heat simulation, 15% of the time; and under conditions of no simulated load, 48% of the time. During 55% of the heating season, the houses were operated with triple glazing on windows and for the remaining 45% of the season, with double glass.

For the initial two months of operation or approximately 25% of the heating season, houses were operated with the living room maintained at 72 F; baths, at 75 F; bedrooms, at 68 F; and stairway and basement, at 65 F. During this period, heat distribution characteristics were determined and following this, all rooms, with the exception of basement and stairway, were set at a constant room temperature of 70 F. The basement was heated to 65 F in two-hr cycles each day for a portion of the time, continuously on 24-hr cycles for another period, and no heat was supplied during a third period. A complete schedule of the different phases of operation together with an analysis of results will be presented in a subsequently to be prepared paper.

It was recognized that it would

[1] Model No. 176—Science Associates, Inc. Princeton, N. J.

be impossible to artificially simulate infiltration through door openings and for this reason, a schedule of twelve door openings for entrance to or exit from the houses were provided manually. These openings were according to a fixed schedule and a logbook was provided to record these and all other manual activities to which the houses were exposed. During one period of operation, the door openings were increased to 24 per 24-hr period and during a few brief periods when inspection of the houses occurred, a much higher number of entrances and exits were recorded. Particular care was taken to obtain an equal number of door openings and entrances to each house. It was recognized that the ventilation to which a house is exposed is, to a great extent, dictated by the living habits of the occupants, and that this varies markedly between families. In the present tests, door openings to which each house was exposed defined the simulated living habits for this particular simulated family.

Additional ventilation was provided by operation of the kitchen exhaust fan during the periods of simulated cooking operations and the ventilation fans for the shower room during the periods when the showers were in actual operation. Further, it was recognized that under actual operating conditions when very high humidities are experienced, ventilation is usually provided by the occupants in order to alleviate these conditions. This ventilation is normally provided by additional door or window openings. In the simulated operation, a humidistat was installed to operate the central shower fan upon demand whenever predetermined excessive humidities were experienced. Doors extending from floor to ceiling permitted good circulation of air when the fan operated.

Each house was inspected daily and these inspections included checking operation of the programmer, circuit breakers, humidifiers, all appliances and all recording equipment. All electric meters were read and camera equipment used to record the midnight meter readings was checked and film advanced. All water consumption meters were read, and a load of clothes which had been washed in the electric washing machine shifted to the dryer. Drapes and shades in each room were inspected and any window condensation noted. Operation of dishwasher, range, fan, and the shower and shower fans were all checked.

The total amount of 1.2 gal of water was introduced daily into each house by the humidifier to simulate the calculated .96 and .24 gal water given off by occupants and cooking, respectively [1]. Daily consumption of all outside service meters were also read and snow depth, if any, adjacent to the house on all sides recorded. All vents were checked to make certain that they they were not obstructed. An exact schedule of operation was provided with each item to be accomplished in sequence in order that there would be no variations from day to day.

Fig. 8 View looking south showing U.S. Weather Bureau type instrument shelter and in background, 30-ft weather mast containing pyrheliometer, weather vane and anemometer

OBJECTIVES

The introduction presented the broad objectives which dictated the planning of this research program. More specifically, they may be subdivided as (a) heat loss studies, (b) temperature studies, and (c) moisture studies.

[1] "Research in Humidity Control", Bulletin No. 106, Engineering Experiment Station, Purdue University, 1948.

Heat Loss Studies — One of the principal objectives of the first winter's studies was to determine actual energy requirements and operating costs under a variety of defined and controlled inside conditions and a complete monitoring of the outside environment. These tests have permitted study of ceiling, wall and floor insulations and the effects of a variety of weather conditions including solar radiation and wind speed and direction upon the energy consumption of individual rooms as well as the complete houses. They have also provided a comparison of actual heat loss requirements with calculated heat losses.

Temperature Studies — Detailed temperature measurements have permitted studies of room air temperature stratification and a comparison of wall temperature gradients with calculated gradients under different operating conditions. These studies include investigation of crawl space and attic air temperatures under different ventilation conditions and basement area and ground temperatures with seasonal variations.

Moisture Studies — Conducted to determine upper limits of indoor relative humidity as a function of the external enviornment, and field studies of effects of double versus triple glazing.

Future Studies—It is intended that these houses be operated during a second winter and that one house be occupied by a family of 4 people living under normal conditions. The second house will be operated under simulated conditions outlined previously for the entire heating season. This will permit a comparison of simulated conditions with actual living conditions and will permit a further evaluation of actual heat energy requirements of residential structures.

ACKNOWLEDGMENTS

This study was sponsored by Wood Conversion Company which wishes to acknowledge the valuable assistance and cooperation of Dr. R. C. Jordan, Professor and Head of the Mechanical Engineering Department, University of Minnesota, as technical consultant on the project. Also the Andersen Corp.; Minneapolis-Honeywell Regulator Company; Edwin L. Wiegand Co.; Northern States Power Co., all of whom have contributed liberally during the planning and executing of the work. The Minnesota Light and Power Co. also assisted in planning.

Rapid and precise control procedures are essentials for quality

Thermoelectric materials

G. V. DOWNING, JR.

Because the usefulness of thermoelectric materials, such as bismuth telluride and lead telluride is a result of their unusual electrical and thermal properties, rapid and precise control procedures are essential to insure the quality of material being produced.

In our laboratories the ratio Z is used as the figure of merit on which our evaluation is based. This is defined as:

$$Z = \frac{S^2}{\rho K} \; C^{-1}$$

where
S = Seebeck coefficient uv/C
ρ = Resistivity ohm-cm
K = Thermal conductivity watts/deg cm

RESISTIVITY

Resistivity is the most sensitive quality control and is the most easily measured. We use an ac method; since these are thermoelectric materials, the use of any appreciable dc current would create both temperature and potential differences between the ends of the ingot which interfere with the measurement. The use of small dc currents is satisfactory but there are problems in amplifying small dc voltages.

A block diagram of the apparatus is shown in Fig. 1. It consists of an audio generator, the output of which is stepped down through a filament transformer in order to get sufficient current through the sample. A standard 0.1-1.0 ohm resistance decade is placed in series with the sample. The voltage across this can be switched to the vacuum tube voltmeter, and hence the current through the sample can be determined and the output of the generator adjusted to give a "known" current, usually 100 or 200 milliamp.

The voltage across a 1 cm interval on the ingot is measured by a two-point probe; this voltage is amplified and read on the meter. The amplifier is adjusted to a gain of 100 by switching the input across the standard resistor and adjusting the volume control.

Resistivity is measured at 1 cm intervals along the ingot at two points on the circumference and the resulting profiles must fall within certain limits. A range of $\pm 1.5 \times 10^{-4}$ ohm-cm is allowed in the case of bismuth telluride. Usually, there are regions at the extreme ends of the ingot which fall outside the range and these are then cut off. Typical values are $10 - 15 \times 10^{-4}$ ohm-cm for "p" type and $5 - 10 \times 10^{-4}$ ohm-cm for "n" type material.

The time required to obtain a profile by construction of a multipoint probe has been considerably decreased. The points are spaced 1.00 cm apart along the probe. By means of a switch the voltage across each pair of points is measured in turn. By adjusting the current in proportion to the area, the resistivity is read directly off the meter and, therefore, may be plotted directly.

Time required to obtain a profile is of the order of five minutes.

SEEBECK COEFFICIENT

The ingot which now has a uniform resistivity profile is next measured for Seebeck coefficient. The ends of the sample are coated with a thin layer of In-Sn amalgam. It has been found that this wets the materials readily and is easily applied. It affords good thermal and electrical contact to the end of the ingot.

How to obtain satisfactory measurements in minimum time on the many samples which are submitted to a control laboratory is the task considered here.

Author Downing reports upon a procedure which reduces the time required to obtain a resistivity profile to about five minutes. It also reduces uncertainties in the measuring of thermal conductivity to permit a routine test with truly comparable results. Also described are procedures for measuring Seebeck voltage and thermal conductivity accurately on a rapid routine basis.

G. V. Downing, Jr., is active in Physical and Inorganic Chemical Research with the Merck Sharp & Dohme Research Laboratories, Div. of Merck & Company, Inc. This paper, here somewhat condensed, was presented as "Production Control Testing of Thermoelectric Materials" at the ASHRAE 67th Annual Meeting, Vancouver, B. C., June 13-15, 1960. The complete paper will appear in TRANSACTIONS.

The ingot is now placed in the apparatus as shown in Fig. 2 with a copper constantan thermocouple at the base, and the heater with the thermocouple through the center is clamped firmly onto the top. Cotton is placed around the ingot to cut down convection. The heater is run at a voltage which gives a temperature differential of about 10 C, and the system is allowed to equilibrate for 15 to 20 min. The thermocouple emf's and the emf between the copper leads at each end of the ingot are measured with a Type K potentiometer and the Seebeck coefficient calculated according to the formula:

$$S = \frac{E_1}{[E_{t_1} - E_{t_2}] \times f} \times 10^3 \text{ uv/C}$$

E_1 = emf between copper leads expressed in mv.
E_{t_1} = emf of hot thermocouple in mv.
E_{t_2} = emf of cold thermocouple in mv.
f = conversion factor C/mv.

The method is reproducible to ±3 uv/C with variables in the temperature at the hot junction or in the length and diameter of the sample showing no effect.

Specifications call for "p" type material having a Seebeck coefficient greater than +180 uv/C and "n" type greater than −160 uv/C. Normal values are +200 to 220 uv/C for "p" type and −180 to 190 uv/C for "n" type.

The sign of the Seebeck coefficient also determines the type of the material "p" or "n" for a positive or negative sign respectively. In addition, we use a thermal voltage probe with a heated copper tip and a copper reference probe to examine the ingot for any evidences of segregation resulting in change of type.

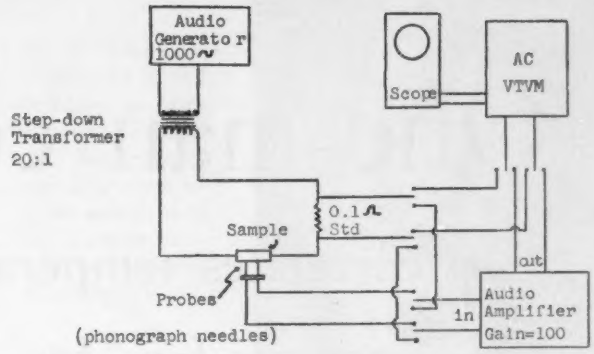


Fig. 1 Apparatus for measuring resistivity

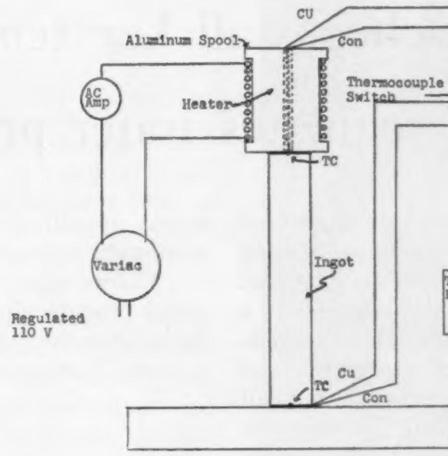


Fig. 2 Seebeck coefficient apparatus

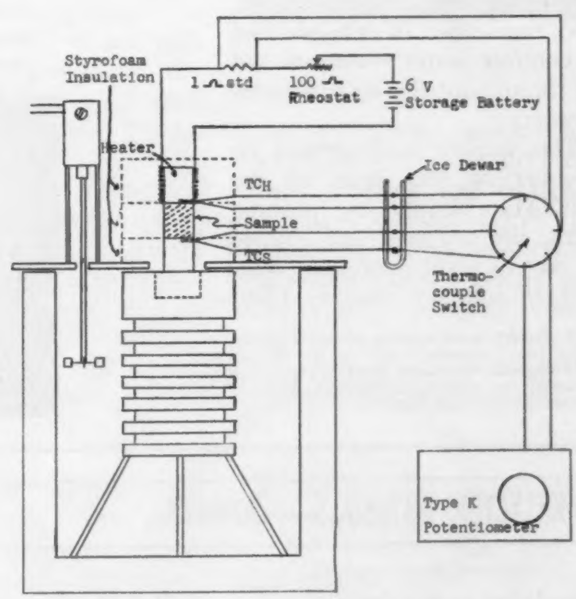


Fig. 3 Thermal conductivity apparatus

THERMAL CONDUCTIVITY

The method for measuring thermal conductivity is a steady-state one. After this method had been developed there came to our attention an article by Ioffe which stated plans for an apparatus of this type. It is actually a logical outgrowth of the transient method. Investigating this method showed that it lacked the reproducibility of ours and because of the computation, time involved was no more rapid.

The apparatus is extremely simple and is shown in Fig. 3. The theory is that the heat put into the heater exactly balances the heat lost through the sample which is placed on a cold sink. By maintaining the heater at room temperature no heat flows to or from the surroundings, thus greatly simplifying the insulating problem.

In operation, the aluminum cold sink is placed in the stainless steel dewar which is filled with crushed ice and water. The lid to which a small stirring motor has been attached is placed on the dewar. An aluminum plug, the upper half of which is machined to the same diameter as the sam-

(*Continued on page 46*)

One-man control center

— correlates temperatures in 28-story building
— operates fans for 52 air-handling systems
— checks all key temperatures
— regulates water pressures and flows

Behind the completely supervised operation of entire air-conditioning system in the new First National Bank building, Minneapolis, is a control center from whose console one man checks, correlates and controls temperatures throughout the 28-story building . . . snaps on or off fans for the 52 air-handling systems . . . checks all key temperatures as interior air is heated, cooled, humidified or dehumidified . . . controls water pressures and flows throughout the air-conditioning system.

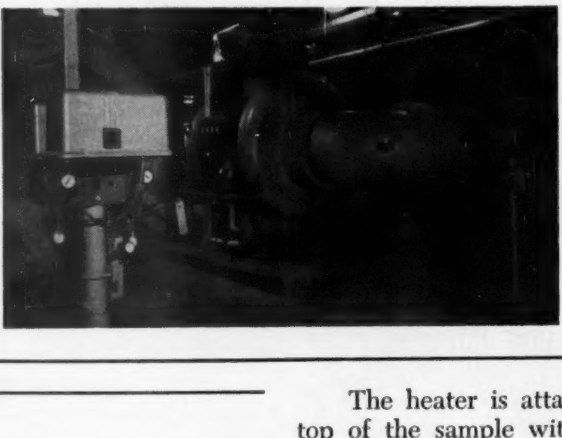
This facility is illustrated on the cover of this issue of the JOURNAL. Simply by pushing buttons, the engineer can change from day to night operation; from winter to summer control. Electronic signals are used to control pneumatic motors and valves.

Color-coded diagrams on the panel provide visual references to the relationships of all system components. Temperatures in any zone on any floor can be read on either of two precision indicators by pushing a button. Turning of a knob adjusts these temperatures upward or downward.

This building has in excess of

Edwin F. Snyder is manager of product development for the Commercial Div of the Minneapolis-Honeywell Regulator Company and vice chairman of the ASHRAE Research Advisory Committee #6—System Analysis.

Fig. 1 Cooling water from three 500-ft wells is circulated through the condensers serving these two (1000-ton and 850-ton) centrifugal compressors and then rejected to a storm sewer connection



THERMOELECTRIC MATERIALS—DOWNING

(*Continued from page* 45)

ple, is placed in the sink. This plug has a small hole for a thermocouple drilled quite close to its upper surface.

The sample which is about 1 cm long is prepared by machining a smooth surface on each end. It is then attached to the sink with a thin film of stopcock grease such as "cellogrease." The heater is made from a copper cylinder of the same diameter as the sample. A small hole for a thermocouple is drilled close to one face. A coating of nail polish is applied and the heating wire is wrapped around the cylinder.

A length of about 12 in. is used which gives a resistance of about 35 to 40 ohm. Flexible copper leads of No. 30 wire are attached to the ends of the heater wire, and the assembly is wrapped with tape. The resistance of the heater is measured accurately with a Wheatstone bridge.

The heater is attached to the top of the sample with the same grease. No. 30 copper-constantan thermocouples are inserted in the holes in the heater and sink. Blocks of styrofoam insulation with holes cut out are used for insulation.

The current through the heater is adjusted by means of the rheostat until the heater thermocouple is at the same temperature as the ambient. Because of the relatively small mass of the heater and the relatively poor thermal conductivity of thermoelectric materials, the heater responds quickly to changes in current.

EDWIN F. SNYDER
Fellow ASHRAE

Fig. 2 This First National Bank building in Minneapolis consists of a 5-story bank and 23-story tower air conditioned by separate systems but centrally controlled

400,000 sq ft of space, is entirely air-conditioned with two separate systems, one for the 5-story bank, the other for the 23-story tower. The air-conditioning problem is compounded by a glass area of nearly 2000 windows and Minneapolis temperature extremes of 100 above in summer and 30 below in winter.

Both bank and tower are provided with interior and perimeter air-handling systems. Temperatures for the interior systems are controlled from the supervisory center, as are those for the air and water in the perimeter induction units. However, individual thermostats vary the water flow through the induction unit coils, giving a 15 F temperature differential between interior and perimeter zones for individual comfort.

Air-handling equipment is on the 27th, 6th and sub-basement floors. There are 29 supply systems, 23 exhaust. Powered by a total of 750 hp, system fans move nearly 900,000 cfm through nearly 20 miles of ducts. Some 25 miles of steam and water piping supply 2200 cooling units. Temperatures throughout the entire building are controlled by 1200 thermostats.

Each interior system cooling coil has a separate 60 hp pump in the basement circulating chilled water through building risers. The small pumps, on 27, 6 and sub-basement floors, draw from this bulk flow to feed individual cooling coils and overcome friction within the coils. Diverting valves ahead of the pump shunt the chilled-water supply to the pump and thence to the coil, or send it into the return line. Temperatures of the chilled water supply and return are indicated and recorded.

All air for interior and perimeter systems passes through electronic air cleaners, which eliminate more than 90% of all dirt particles from incoming and recirculating air. Bank officials figure the 25 electronic air cleaners will not only make substantial savings in air-conditioning operating costs, but will also drastically reduce cleaning expenses as well as improving employee health and morale.

Only 10 to 15 min are required to bring the system to equilibrium. The current is then measured by measuring the voltage across the standard resistor, and the temperature of the cold sink is measured. The thermal conductivity is then calculated.

$$K = \frac{I^2 R \times l}{A \times (T_H - T_s)}$$

I = current through heater
R = resistance of heater
l = length of sample
A = area of sample
T_H = temperature of heater
T_s = temperature of sink

The apparatus was checked by using borosilicate glass, and the value obtained was 0.0105 watt per deg/cm which is the value given by the National Bureau of Standards for this material. Reproducibility is $\pm 2\%$. Typical values are given:

Material	
Bi_2Te_3 "p"	0.017 watt per deg/cm
Bi_2Te_3 "n"	0.0190
PbTe	0.040
Glass	0.0105
Bi_2Te_3 doped	0.0153

Some investigation was made of the errors inherent in the method. One was the effect of sample length; since the entire sample is below room temperature, some error would be anticipated from heat flowing into the sample from the surroundings.

It was found that glass samples up to two cm in length showed no error, but longer ones gave the lower values one would expect. Thermocouples placed in the sample showed a linear temperature drop for the two-centimeter sample but a non-linear profile for a 4-cm piece.

This method has reduced the time and uncertainty in measuring thermal conductivity and made the measurement a practical one for routine purposes. Fifteen samples can be run in a day with ease.

Our ASHRAE Environmental Research Program

BURGESS H. JENNINGS

Environmental research activities of our Society have always elicited intense interest within and outside of the Society. Thus it is not surprising that the recent environment papers have produced extensive comment and discussion. Because of the widespread character of this interest, it seemed advisable at this time to reproduce for the JOURNAL some of the discussions which have been received along with replies to them, to explain points about which misunderstandings have arisen and to tell something about the present and future programs. However, before discussing recent papers and the present program, it would appear desirable, at least superficially, to survey prior environment research by the Society.

HISTORICAL BACKGROUND

The first significant contributions of the Society to our knowledge of environment were made in 1923 when F. C. Houghten and C. P. Yaglou presented their distinguished study entitled, Determining Lines of Equal Comfort.[1] The authors in the same year presented a second paper entitled, Determination of the Comfort Zone.[2] The latter supplemented the first and developed the concept of "effective temperature," a significant contribution at that time. This paper also presented the first comfort chart of the Society. The next step related to the comfort chart took place in 1925 when C. P. Yaglou and W. E. Miller presented a study entitled, Effective Temperature with Clothing.[3] In this paper the previous comfort chart was modified to account for conventional clothing and considered individuals normally clothed and slightly active. That chart, prepared in 1925, with hardly any change represents the comfort chart still in use by the Society. In the same paper, another chart was prepared which analyzed human response relative to air motion, a study in turn based upon Society work reported in 1924 by W. J. McConnell, F. C. Houghten, and C. P. Yaglou entitled, Air Motion—High Temperatures, and Various Humidities – Reactions of Human Beings.[4]

Society work relative to the comfort chart in its basic details was thus completed in 1925. This did not mean that additional work was not done by and for the Society subsequent to that date, as the subject was extremely intriguing and a notably important one, but with one exception the other investigations did not affect the comfort chart. This additional paper was presented in 1929 by C. P. Yaglou and Philip Drinker and entitled, The Summer Comfort Zone: Climate and Clothing.[5] In it the authors superposed on the comfort chart of 1925 a statistical summary of conditions representing comfort in summer and in winter. This additional information with but slight modification in redrawn form now appears on the current comfort chart in the 1960 GUIDE of the Society.

The next important physiological work, done in the Society's

Burgess H. Jennings is Director of Research, ASHRAE Research Laboratory, Cleveland, Ohio.

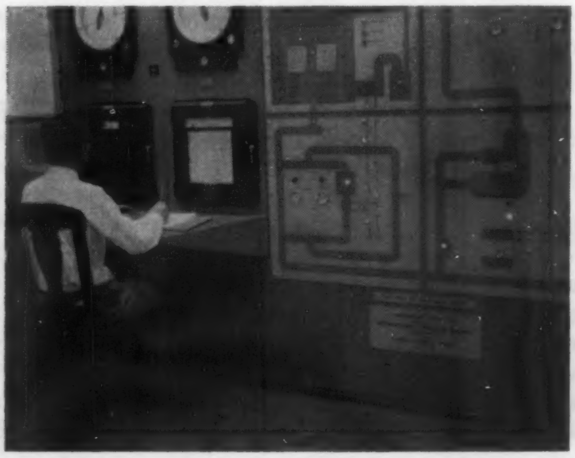


Fig. 1 Outside view of Environment Room of ASHRAE Research Laboratory in Cleveland

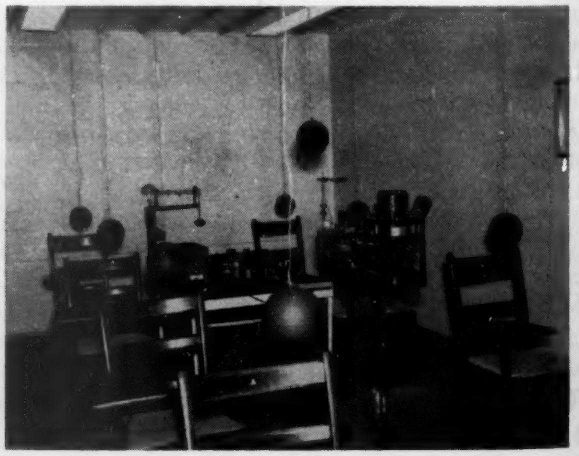


Fig. 2 View of Test Room undergoing calibration for radiant conditions before entry of subjects – globe thermometers in use

Laboratory, was reported in 1936 when F. C. Houghten and Carl Gutberlet presented Comfort Standards for Summer Air Conditioning.[6] This paper discussed a prior standard of the Society and considered cooling shock on entry to air conditioned space in relation to outside temperature variations.

No matter how carefully research work is done and its results critically analyzed before publication, criticism arises, and the environmental work of the Society has not been an exception to this rule. In particular, the concept of effective temperature as a measure of equivalent thermal sensations for the individual has been subject to criticism, largely because there appeared to be evidence that the effect of relative humidity on comfort was overemphasized by the slope of the effective temperature lines. This fact led to a plethora of other indexes being proposed, many of them with fine underlying research work of justification. Space does not permit here a detailed description of these indexes, among which should be mentioned, Equivalent Warmth,[7] Operative Temperature,[8] Equivalent Temperature,[9] The Heat-Stress Index,[10] The Predicted Four-Hour Sweat-Rate Index,[11] but they have been described quite adequately in the literature and summarized in references 12 and 13. In addition to this, Professor C. P. Yaglou, one of the co-originators of effective temperature, presented a paper in 1947 entitled, A Method for Improving the Effective Temperature Index,[14] in which he explored reasons why the influence of humidity in the comfort range appeared to be overemphasized.

Not only continuing work carried on by other laboratories, but many field studies showed lack of agreement between observed effects and the 1925 comfort chart of the Society. For many years, therefore, pressure was placed on the Society to re-evaluate the variables associated with comfort and redetermine the important parameters. This thinking was culminated in 1950 by a recommendation of the Committee on Research of the Society to start planning a comprehensive program with required facilities to permit the determination of new data where required and permit re-evaluation of other data that appeared to need further scrutiny. Although proposed in 1950, active inauguration of construction, along with a simultaneous study of all of the literature in this field, did not start until 1955; and it was not until 1957 that the new research facility at the Laboratory started in operation.

From that time to the present the Laboratory has been in continuous use developing subjective data. It is unfortunately true that in this field research results cannot be hurried, as it is absolutely essential that every measurement be checked and rechecked before it can be released. Moreover, the amount of research required to obtain a clear picture of human response to all aspects of the environment is almost unbounded. This means that in exploring the broad field it is necessary to work over a narrow band of conditions and to obtain answers which are necessarily applicable primarily to those conditions. Research practice from time immemorial has been to make available the results of research as these are obtained, even though the results in most cases cannot give a picture of all the patterns relating thereto. The Laboratory was faced with a decision of this type as to whether it should release segments of information as these were found or wait until a complete and extensive pattern could be assembled. The predominance of opinion was to release specific research information as soon as it was felt that a pattern had been fully investigated and the results were unequivocally true.

To date two papers have been released; the first, which appeared in early 1959, was entitled, Environment Reactions in the 80 to 105 F Zone,[15] by Jennings and Givoni. This paper endeavored to explore the patterns of subjective response in a hot, non-comfort region and, in addition, investigated some aspects of subjective response to still air and moving air. It did not explore the comfort zone nor was it intended to. The second environmental study, which appeared in early 1960, was entitled, Sensation Responses to Temperature and Humidity under Still-Air Conditions in the Comfort Range,[16] by Koch, Jennings, and Humphreys. This investigation, centered in the comfort range, explored fringe conditions on both sides, but was limited to still air, to lightly-clothed, seated individuals at rest, and a radiant environment essentially uniform and adjusted to correspond to the dry-bulb temperature. The research of each paper is applicable to its own region, and extension of the data into other zones can lead to serious misinterpretation. Where the two papers can be compared, the agreement has been remarkably gratifying to the authors. It has unfortunately been true, however, that on a number of occasions readers of these papers have endeavored to use the data presented out of their context with unfortunate results.

To carry on this discussion of environment research, it appeared desirable to present at this time the types of questions and discussions which have appeared concerning the Society's current environment program. Thus, in succeeding paragraphs a number of heretofore unpublished discussions relative to these two papers are presented, followed by the answers given by the authors. With this background available to interested readers, this article concludes with a report on current research under way at the Laboratory, followed by a summary of the continuing program that the Research Advisory Committee on Environment and the Research Panel on Physiological Research and Human Comfort are proposing in this field.

DISCUSSIONS

Discussion of W. H. Mullins, Philadelphia, Pennsylvania – It was stated in the Koch, Jennings, Humphreys paper,[16] ". . . comfort is primarily dependent upon the dry-bulb temperature and is so little dependent upon the humidity that this factor is frequently not even mentioned." To design for latent load means some consideration of humidity and its control and also often means an elaborate control system to give a desired humidity. If this humidity factor were disregarded and only the dry-bulb temperature used as a design criterion, considerable air-conditioning problems would result, particularly in areas where 90% relative

humidity is experienced over extended periods. In the paper there is a change in optimum wintertime temperature from a 66 F effective temperature line to a 68 F temperature line. This was due to a change in the type and weight of clothing worn. Wouldn't a similar change to lighter summer clothing influence the results, causing them to differ from previous work which may have used different type and weight of clothing? A repeat of your tests twenty years from now may not completely correlate if the weight and type of clothing is not held constant.

In the optimum comfort region, line 4, Fig. 6, of Environment Study II,[16] humidity has less effect on comfort than at higher dry-bulb temperatures. This is confirmed in the study; however, this humidity effect seems to be overly-minimized, whereas in previous work it was overly-emphasized. Engineers, through experience, recognize the shortcomings of the present comfort tables and have made their own corrections and allowances. It would be helpful to have the engineer obtain similar experience on this new information.

Reply by C. M. Humphreys – We agree that almost every comfort air conditioning system is designed to handle some latent load. This is the proper procedure and nothing in this paper should be interpreted as indicating otherwise. On a hot, humid day, if the dry-bulb were lowered sufficiently to produce a comfortable temperature without the removal of moisture, serious problems totally unrelated to comfort could develop. However, as stated in the paper, we still believe that it is both possible and customary to define comfort conditions in terms of dry-bulb only. At higher temperatures, relative humidity becomes a second parameter which must be included.

In referring to the effect of clothing in changing the optimum E. T. from 66 to 68 F, we also were suggesting the possibility of a shift to still higher temperatures because of the very light clothing being worn today. May we again emphasize that this paper reports on only one facet of the extensive problem related to the effect of environmental conditions on human comfort. The data applies to the limited conditions described in the paper. As further data are compiled on the other parts of the problem, a more comprehensive picture will most assuredly become apparent.

Discussion of Professor Ralph G. Nevins, Manhattan, Kansas – The ASHRAE Research Laboratory staff and the members of the former TAC on Physiological Research are to be commended for their efforts in preparing and initiating this program of environmental studies. However, the subject is so complex that further data are needed to provide a complete and accurate picture of man's response to this thermal environment. The authors' conclusions should be studied with care and in context. Serious misapplication could result if the limitation imposed by the test conditions are not recognized. Data are not presented which would allow an estimation of radiation, although mention is made of this factor. The curves in Fig. 6 (from Ref. 16) and the discussion of the statistical methods are of great value. It is hoped that future studies will solve further problems and that a future comfort chart will include corrections for air velocity, radiation, and activity.

What use, if any, was made of the subject votes regarding sensible perspiration, humidity sensations, and pleasantness? To what degree are these data of value in comfort studies?

Reply by C. M. Humphreys – We thank Dr. Nevins for his kind and encouraging remarks, and for so clearly restating and stressing the limitations imposed on the data by the conditions of the tests. This paper is only a first step toward the general solution of the complex problems encountered in the relationship of thermal environment and human comfort.

To date, no use has been made of the subjects' votes on sensible perspiration, humidity sensation, and pleasantness. We cannot be sure that these data for comfort-level tests will ever have great value. However, it costs little or nothing to gather this additional information while the tests are being run.

Discussion of Baruch Givoni, Haifa, Israel – A former study from the ASHRAE Research Laboratory indicated that the effect of increasing humidity below 85 F has much more effect on the sensible perspiration than on the thermal sensation, and the feeling of wetness might be the main cause of discomfort associated with high humidity. Does the present investigation confirm this?

The slopes of the weight loss lines in the ASHRAE Research Laboratory study published in January, 1959, suggested that, below 80 F, the increase of humidity reduces weight loss. This is confirmed by the data published by Inouge et al., Effect of RH on Heat Loss of Man Exposed to Environments of 80, 76 and 72 F (ASHVE Transactions 1953), and by Warden, Fahnestock, and Galbraith in the article, Thermal Comfort of Clothing of Varying Fiber Content (Textile Journal, August 1959). It would be of interest to compare the present results with those above.

Also, in the January, 1959, paper of the ASHRAE Research Laboratory,[15] it seemed that, although the pulse rate and oral temperature did not change with sufficient significance as a response to the change in air temperature in this zone, they responded more significantly to changes in humidity. What are the results of the present study?

Reply by C. M. Humphreys – The January, 1959, paper presented the results of tests made at temperatures ranging from 80 to 105 F. In these tests, in which the conditions were above the comfort level, sensible perspiration, weight loss, and changes in pulse rate and oral temperature were significant variables. However, in the series of tests at or near the comfort level, the values of these variables were minimal. These data have not yet been completely analyzed but will be studied further; and if any significant trends are indicated, they will be reported at a later date.

Discussion by John Everetts, Jr. – Since the presentation of the subject paper at the Dallas meeting, I have endeavored to analyze the data presented in this paper and

compare it with the data presented a year ago in the progress report entitled Environment Reactions in the 80 to 105 F Zone, by Jennings and Givoni,[15] presented at the Annual Meeting of ASHAE in Philadelphia in January, 1959. I have also tried to compare the data presented in these papers with some of the previous work in the Laboratory and others.

Fig. 3 shows a copy of the Comfort Chart in which the results of both papers are overlaid in terms of the "sensation numbers" as they were presented. No. 3 is stated colder than optimum, No. 4 is supposed to be optimum, and No. 5 is warmer than optimum. Also included is a dash line, numbered 6, which is vertical (no humidity effect) from the 1959 data.[15] The solid lines are from the 1959 report, and the broken lines from the 1960 paper.[16] Sensation No. 3 for the 1959 report has been extrapolated from Fig. 5 of the report from 75 to 68 F at 33%, and from 80 to 71 F at 85%.

The findings for sensation No. 5 are 7 F higher in the 1959 report[15] than for the 1960 paper.[16] Sensation No. 4 is in close agreement at 33% RH, but 2½ F off at 85% RH. The findings for sensation No. 3 show a close agreement at 85% RH but are off over 4 F at 33% RH. Since the major conclusion is the absence of humidity effect and the lines shown in Fig. 3 are straight, the extrapolation for sensation No. 3 appears to be justified.

The vertical line indicating no sensation reaction to humidity (for the 1959 report) is at 80 F, which is 4 F over the generally accepted optimum, while the vertical line in the 1960 paper is at approximately 72, which is 4 F below the accepted optimum.

The 1959 report indicates an optimum of 79 F at 85% RH, and 78 F at 33% RH. The 1960 paper concludes the optimum to be 77.6 F at 30% RH, and 76.5 F at 85% RH and "only slightly dependent on humidity."

In the 1959 report, the clothing for the men consisted of a sports-type shirt with short sleeves, light underpants, socks, and according to the photograph, long trousers.

In the tests conducted at the

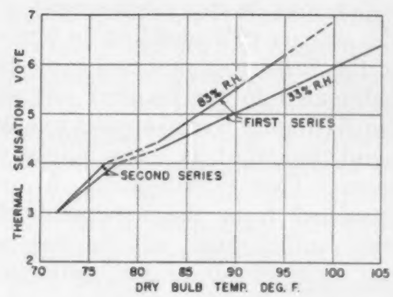


Fig. 3 ASHRAE Comfort Chart, 1958 GUIDE, with superposed lines used in discussion of John Everetts, Jr.

Laboratory in 1936, referring to Page 217 of the Transactions for that year, it will be noted that the clothing worn consisted of athletic underwear, a light-weight shirt with collar attached, tie, light socks, light-weight summer coat and light flannel trousers. There is certainly a great deal of difference in the sensation of comfort between a long-sleeved shirt with collar and tie which fits snugly around the neck, compared to a short-sleeved sports shirt with open collar. As far as my observations are concerned, I have rarely seen a man in an office building who does not wear a long-sleeved shirt with collar and tie. In some cases, he does not wear a coat and may roll up his shirt sleeves.

The results of the tests made at the University of Illinois and reported in Paper No. 1480 in Transactions No. 59, 1953, Pages 329-346, with subjects clad only in union suits showed practically no effect of relative humidity between 30 and 80% at 72 and 76 F but a decided difference was noted at 80 F. (Sensation No. 4.4 at 30% to No. 5.4 at 80%, Fig. 1, Page 333.)

The following observation is quoted from Page 337: "Immediately upon entrance into the psychrometric room from the staff office, the men still dressed in their street clothes always felt the environment with an 80% RH to be warmer than the one with a 30% RH. In an environment maintained at 80 F, the difference in sensations persisted throughout the exposure."

In the 1959 report, the last sentence on Page 9, referring to thermal sensation number vs. sensible perspiration number, states as follows: "One basic difference between these responses is that the thermal sensation is almost instantaneous and does not change appreciably with time of exposure in a constant environment."

In the middle of first column of Page 7 of the 1960 paper, the following statement is made: "As previously stated, the new work is based on the appraisal of the environment after approximately three hours occupancy. However, the effective temperature index was established on instantaneous judging as the subject moved from one psychrometric chamber to the other."

These two statements appear to be contradictory. Furthermore, the 1936 work of Houghten reported in Paper No. 1035, on Page 215 of the 1936 Transactions, specifically shows that the subjects were tested over a three-hr period, and the elapsed time for the subject to establish a complete sensation equilibrium was seldom less than a 30-min period.

There is nothing in these publications to indicate that these inconsistencies were considered or resolved in the conclusions. The differences are so great that I feel they should be considered in light of previous work to determine wherein the deviations occur and how they may be resolved, if possible.

Reply to the Discussion of John Everetts, Jr. — Much of this discussion is based on the assumption that data determined in one regime are applicable to a distinctly different regime. This is somewhat surprising, as the pitfalls of extrapolation are normally so well recognized that most engineers studiously avoid the practice. It is not, then, surprising that the extrapolation carried out in the discussion produces irrelevant and erroneous conclusions. The discussor has presented his work in Fig. 3 which contains his lines and some from the papers. Those from the papers reading from left to right are the second No. 3 line (dotted), the first No. 4 line (dotted), the first No. 5 line (dotted), and the last No. 5 line (solid). The remaining lines on this chart result from the discussor's extrapolation and represent his own thinking but, as will be shown, are not conclusions implied in either paper. In particular his

solid lines 3 and 4 are the result of extrapolation and the dash line No. 6 which the discussor states is a "vertical line indicating no sensation reaction to humidity" is similarly a limiting condition from the 1959 data. Factually, the 1959 data for the hot region showed that humidity had a great effect on response in its full spread, but relative-humidity effect minimizes as the severity of the conditions becomes less.

Before discussing further comparisons of the extrapolated lines, it is necessary to explore the significance of the sensation numbers, as in particular he makes a statement, which should be answered, that sensation No. 5 in the 1959 report is 7 F higher than in the 1960 paper. This he points out as an inconsistency. Before reaching a conclusion in this regard, let us analyze what is meant by the sensation numbers. The basic scale for thermal sensation used by the subjects is as follows:

1. Cold
2. Cool
3. Slightly Cool
4. Comfortable
5. Slightly Warm
6. Warm
7. Hot

On this scale, No. 4 is the number representing comfort, which may be described simply as the absence of discomfort. In terms of this scale, to a group of subjects habituated to the comfort region, No. 5 (slightly warm) applies to any condition that is even slightly warm. Thus sensation No. 5 approached from the viewpoint of the comfort range will be only a few degrees above the optimum line of comfort. Consider, however, approaching sensation No. 5 from the opposite direction; for example, from the viewpoint of a subject in an environment at perhaps 95 F. To this subject a change of environment even to 88 F would be a great relief, and it is highly probable that a change of one point in his recorded sensation would take place. Let us now consider the maximum sensation No. 7 (hot). Depending upon the subject's viewpoint, hot may be anywhere from say 95 F to the highest temperature that could be endured for short periods of time, say 135 F. Yet, from another viewpoint, the subject might consider that the lower part of this range is merely warm, giving it a No. 6 value. The important thing is that, in any group of tests, consistent values must be established relative to the subject's frame of reference.

The fact then that the No. 5 sensation is different when approached from the hot region than when approached from the comfort region leads to the obvious conclusion that it is purely fortuitous if the same value is given to No. 5 under different testing regimes. In addition to the two papers in which it was mentioned that No. 5 differed by 7 degrees, attention might be called to the paper of Professor Ralph Nevins, No. 1630 (1958 Transactions),[17] where from the one point of his tests that can be compared, his No. 5 value is approximately 3 degrees higher than the 1960 data indicate and 3 degrees lower than the 1959 degree data. Should we, therefore, conclude that his work is questionable, because it does not agree with either of the Laboratory values, or must we arrive at the conclusion that any of the three values are satisfactory provided the data on which they are determined are internally consistent?

Let us now consider the discussor's extrapolation of hot-region data to show that the optimum comfort line as indicated from the extrapolation is not in agreement with the optimum comfort line as determined from the 1960 series of carefully conducted tests. If they should agree, it would be only by

Fig. 4 Thermal sensation lines at a high and low relative humidity plotted from the Data of Environmental Studies I and II at a high and low relative humidity, Refs. 14 and 15

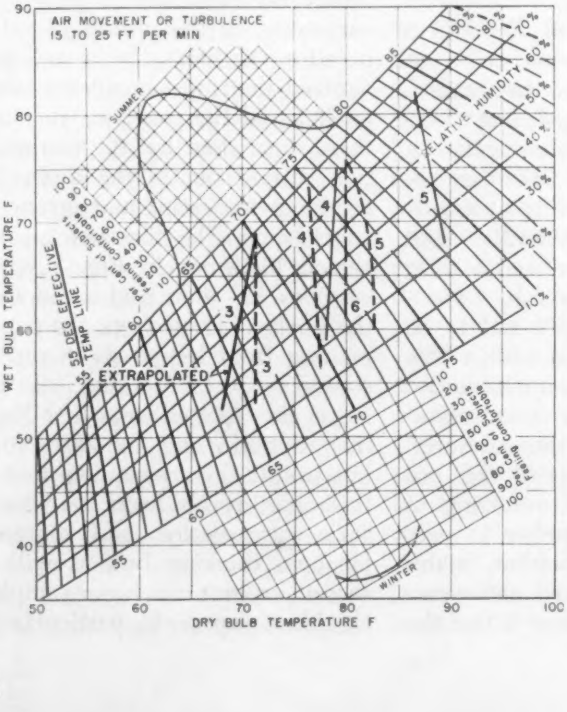
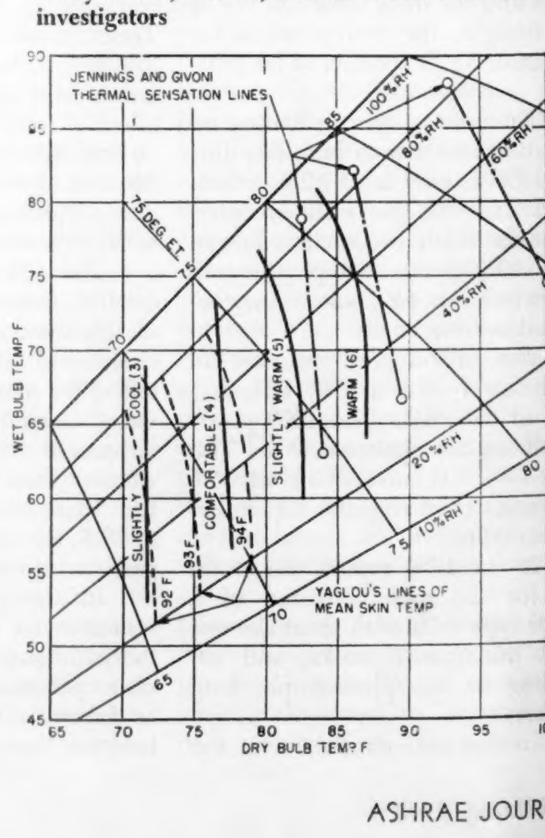


Fig. 5 Comparison of Data of Environment Study No. II, Ref. 16, with the result of former investigators



happenstance and for no other reason. The authors of the hot-region paper would have been wise to have completely stopped their graphs above 80 F, as it was there the testing was really concentrated. As comfort was not a part of this paper, the authors felt absolutely no justification at this point in making any comfort conclusions based on inadequate data.

However, because the discussor has brought up the question of extrapolation, it appeared advisable to explore the data of both papers; and in Fig. 4, pertinent data have been plotted to bring out what was involved. The two solid lines at the right of the figure show the relationship determined for the hot environments of the earlier paper[15] between dry-bulb temperature and thermal-sensation vote for the 83 F and 33% relative-humidity conditions. The solid lines at the left of the graph show similar relations obtained at, or near, comfort levels in the second paper.[16] The solid lines from the earlier paper apply to the range over which the subjects were actively tested; namely, 82 F to 95 F and 82 F to 102 F and above. Dotted lines were then used to connect the two testing regimes, as it is obvious that for the complete spread from hot to cool conditions the plots are far from linear in character. Fig. 4 shows how the striking effect of relative humidity in the hot region gradually minimizes for inactive subjects as conditions become more comfortable. If, however, the diverging lines from the hot region are erroneously continued as being linear, they quickly intersect in the region of the 4 sensation to indicate an untenable conclusion. From an analytical sense, sensation point 4 from paper II represents an optimum value, but it is recognized that there is a spread to both sides of this optimum value over which the sensation of comfort would hold for many individuals.

There is no assurance that the thermal-sensation scale of 7 points will correspond to equal temperature spacing on a graph, and thus there can be no sound basis for assuming that the curves connecting the sensation points on a graph and using temperatures as its abscissa are linear. This appears to hold in Fig. 4. When the data of Fig. 5 (1959 paper)[15] were plotted, a straight line for the range under consideration gave a fair average for the points in question; and for this reason, lines were thus drawn without curvature and without endeavoring to distort the data by changing slope to make them agree with what the value 4 might have been thought to be. Considering the form that the data actually take, the point of extrapolating to predict the cold No. 3 sensation from subjects tested in a hot range certainly appears to be ill-advised and without justification. Moreover with the high- and low-relative humidity lines converging as they do, any conclusions after they intersect would be highly suspect. In the minds of the authors, the only point which can be concluded from the data as they appear is that as the dry-bulb temperature lowers, there appears to be less influence of relative humidity in determining the comfort of an individual.

The discussor raises the question of type of clothing used by the subjects. This is a very important item and one to which we have given the greatest thought. We recognize that other tests need to be run with subjects more heavily clothed, as it is important that our industry have knowledge as to the manner in which clothing affects subjective response. At the present time, the only conclusion that we have made in these papers is that the results reported are for lightly-clothed individuals. We certainly agree wholeheartedly with the discussor that an office worker wearing a coat with collar and tie will react differently to environmental conditions than will the lightly-clothed individual. Moreover, we fully realize that the degree of activity of the subject is important and that subjects walking around, working on files, operating machines or carrying out assembly processes will require lower temperatures for comfort than will lightly-clothed, seated subjects engaged in restricted activity.

We certainly agree with the discussor's comment relative to the test at the University of Illinois, paper No. 1480, which indicates that the humidity effect is noted at 80 F. This point is definitely outside of the comfort region even for inactive individuals, and the problem of dissipation of sweat generated for removal of heat cannot be disregarded. A study of Fig. 6 of the 1960 paper (reproduced here as Fig. 5) shows that this is definitely in agreement with our findings, and the same result appears in the interconnected graphs of Fig. 4.

Let us now reply to the fourth and fifth paragraphs from the end of the discussor's remarks where he quotes the statement in the 1959 hot-zone paper as follows: "One basic difference between these responses is that the thermal sensation is almost instantaneous and does not change appreciably with time of exposure with constant environment." In contrast to this, he quotes from the 1960 paper as follows: "As previously stated the new work is based on the appraisal of the environment after approximately 3 hours occupancy; however, the effective temperature index was established on instantaneous judging as the subject moved from one psychrometric chamber to the other." The discussor contends that these two statements appear contradictory, which is certainly the case if you take them out of context.

The truth of the matter is that our tests show a subject has an instantaneous thermal-sensation response on entering any room, but this is not necessarily a response which remains invariant throughout a test. The constancy of the sensation depends upon a number of factors, one of the most significant being the temperature in the space. For example, consider a space at 90 F and 80% relative humidity. A subject on entry receives an immediate hot impression when he enters the space, and the same impression continues although the body quickly brings into play its heat-dissipating forces to make it possible to exist in this uncomfortable environment. Our tests show that equilibrium is reached in a very short time under such hot conditions, varying from 30 min to an hr; and a subject's vote which starts off in these hot-range conditions at No. 5 or No. 6 remains there as long as he stays in the hot environment. On the other, hand, consider the case of the subject entering an environment that is in or almost in the comfort range

as was treated in the 1960 data. The initial impression of the subject may be that of true comfort, slightly cool or slightly warm. The environmental conditions are never very far from the conditions under which the subject's system can obtain a good balance and when the temperature is near to optimum for comfort, the time response is definitely lengthened. The following unpublished analysis of our data[16] brings out this point very clearly as it shows the test averages over the full period of occupancy. The first row represents a slightly cool condition, the second row almost comfort, and the third row an overly warm condition.

Average Votes Cast by Subjects

No. of Tests	Time of Voting 9:15	9:45	10:15	10:45	11:15	11:45	12:15	Differences Between 9:15 & 12:15 Votes
24	3.60	3.49	3.52	3.31	3.28	3.16	2.92	0.68
35	4.35	4.25	4.20	4.10	3.97	3.94	3.89	0.46
21	5.12	5.10	5.20	5.08	5.02	4.90	4.86	0.28

A study of these averaged values shows that equilibrium is not completely reached even after three hours; however, at this time the data are rapidly becoming asymptotic, and there is no reason to run a longer period. It is interesting to note that, in the case of warm environment (lower line), the difference between the initial reading and the final reading is much less than in the other cases; and an extension of the warm data into the hot region as was done in the first series of tests confirms the accuracy of both statements for the ranges to which they apply.

In his next to the last paragraph, the discussor comments on the 1936 work of Houghten reported in paper No. 1035 (Ref. 6) and states that the subjects were tested over a three-hour period. The point we raise is the fact that paper No. 1035, as quoted above, had nothing to do with the establishment of the present comfort chart as this was developed and described in References 1 and 2 of the 1923 and 3 of the 1925 ASHVE Transactions, at much earlier dates and the applicable quotation from Reference 1 reads as follows: "The dry- or wet-bulb temperature, or both, of the first chamber are then allowed to slowly rise while the judges pass back and forth from one chamber to the other, each time recording their judgment as to the relative feeling of warmth of the two conditions." A number of two-hour tests were also run by these authors in connection with the reported data of Reference 2 and the resultant comfort chart did give some effect to longer period testing, although it was overweighted with short-impression valuations. It is interesting to note that even at this time (1923) the problem of initial impression in relation to longer-term occupancy was receiving attention. The work of the later 1936 paper[6] related to cooling shock, and the statement from the authors of that paper that comfort can be expected after "20 to 40" min (30 min average) is not unreasonable. The curves of that paper interestingly enough do show in Figs. 3 to 7 that body temperature, however, had not stabilized even after 2.5 hours.

SUMMARY OF DISCUSSIONS

It is extremely difficult to present the results of research so clearly that misunderstanding can be completely eliminated, and this is particularly true when data are used outside of the range to which they are applicable. The authors have been very pleased with the internal agreement of the current researches, and also feel that the differences indicated between the present work and the much earlier work of the Society are not nearly so drastic as would appear. In Fig. 5 the slope of the No. 4 line, based on the data of Sensation Paper II, does differ from the slopes of the neighboring effective temperature lines which were reproduced from the current comfort chart in the Society's 1960 GUIDE. This indicates a disagreement with earlier data of the Society insofar as the effect of relative humidity is concerned. Yet, how much of this disagreement arises primarily because the frames of reference for the early and recent data are different, and how serious is it when each test program is considered in its proper perspective? The recent data apply to quiet, lightly-clothed individuals after a long period of occupancy; and in the comfort area, it would be expected that, with such inactive subjects, humidities even in excess of 70% would not disturb thermal comfort. Also with the low activity level of the individuals, a somewhat warmer temperature would be indicated for optimum comfort than would be proper for more active individuals. In contrast to long-period occupancy, the effective temperature lines of the Comfort Chart, which are also lines of equal thermal sensation, were based on short-period judgments made by subjects as they passed back and forth between two test rooms controlled at slightly different conditions. For the most part, they appraised the conditions in one room as being cooler, the same, or warmer than in the other. In the light of our present knowledge, adsorption or desorption of moisture from the exposed skin and clothing of the subjects must have had an appreciable effect on these appraisals.

The complexity, therefore, of the problem of determining a comfort chart applicable to all conditions is immediately apparent and accounts for a number of the questions which were directed at some of the early work of the Society. It thus appears to the designer, selecting comfort conditions, that a compromise or balance must be taken to allow for the type of occupancy, or of activity, kind of clothing, and to some extent period of time in which the users of the space will be present. No comfort chart is yet available which evaluates all environmental conditions and rates of activity. The recent data also reveal, even with subjects who are quiet, that as the temperature conditions become warmer than those required for comfort, the undesirable effects of higher humidities become increasingly obvious. This can be observed from the manner in which the lines of equal thermal sensation (Fig. 5) indicate that lowered temperatures are required as the humidity increases.

A general outline of the envi-

(Continued on page 88)

Thermoelectric refrigeration

now competitive for applications to 300 Btu/hr

P. F. TAYLOR

L. A. STAEBLER
Member ASHRAE

Predictions as to the competitive position of thermoelectric refrigeration, made in "A Comparative Study of the Manufacturing Costs of Thermoelectric and Mechanical Refrigerating Systems" (ASHRAE JOURNAL, July 1960), were too conservative as to time and capacities. Then, thermoelectric systems seemed two years off for the 200 Btu/hr ratings.

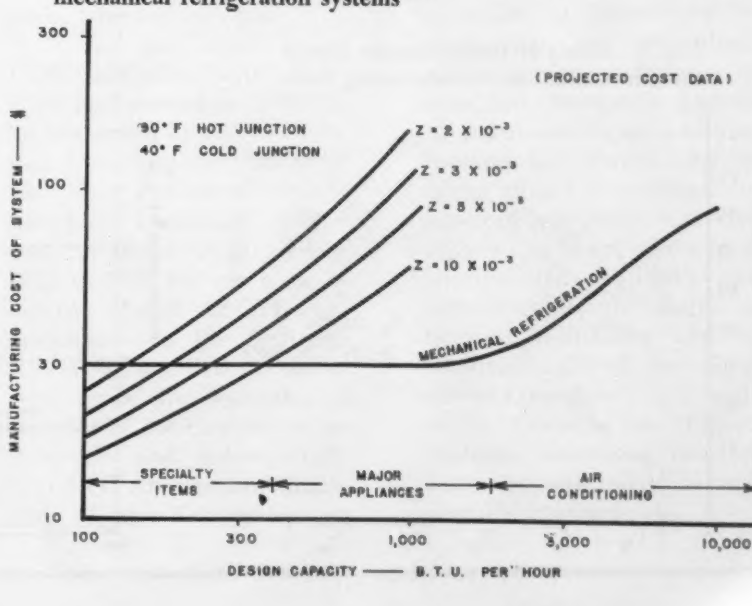
Progress by manufacturers of TE materials in cost reduction, coupled with advances in design and technology of TE systems, put commercial thermoelectric refrigeration right in the present for some applications to 300 Btu/hr.

A recently published paper[1] indicated that at some time within the next two years, thermoelectric refrigeration would become competitive with mechanical systems in regard to manufacturing costs for capacities up to 200 Btu/hr. This prediction was based upon the assumptions that material would be available at \$0.085 per gm with $Z = 3 \times 10^{-3}\ C^{-1}$, by virtue of contact resistance within the thermoelectric (TE) couple and thermal leakage considerations the couple leg length would not be less than ¼ in. and on currently estimated cost of dc power supply manufacture. Results of the cost study in that paper have been summarized and are here shown in Fig. 1.

Since this study was carried out, improvements in materials manufacturing techniques have made possible fabrication of complete TE couples today, in production quantities and at a price comparable with that used in the cited study. (The information on TE material costs and improvements in the Figure of Merit upon which these predictions are based were supplied by the Materials Electronic Products Corporation [Melcor]. The level of production at which the cost predictions would be fulfilled represents about 1% penetration of the current domestic refrigeration market in terms of total Btu/hr capacity.)

With regard to future prospects, attention is drawn to Figs. 2, 3 and 4. Fig. 2 shows the effect of TE couple miniaturization on manufacturing costs. Improvements in junction contact resistance and as-

Fig. 1 Comparative manufacturing costs of thermoelectric vs mechanical refrigeration systems



[1] A Comparative Study of the Manufacturing Costs of Thermoelectric and Mechanical Refrigerating Systems, D. W. Scofield, P. F. Taylor and L. A. Staebler, (ASHRAE Journal, July 1960).

P. F. Taylor is Project Scientist and L. A. Staebler is Manager Advanced Development Department of the Appliance Div, Philco Corporation.

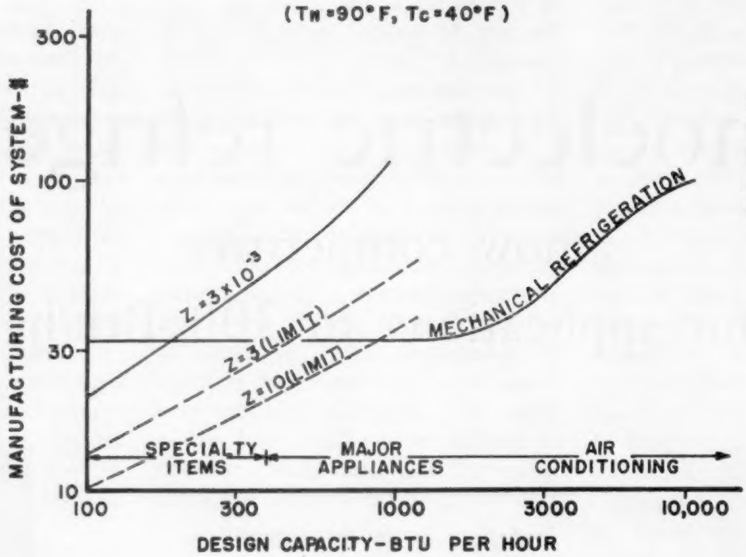


Fig. 2 Effect of thermoelectric couple miniaturization on manufacturing costs

sembling techniques will make possible the construction of efficient TE couples with leg lengths less than ¼ in., which will result in considerable savings in TE material costs. Fig. 2 illustrates savings that can be made in this respect for various design capacities. Naturally, cost reductions are much more evident for larger capacity devices employing more TE couples.

The ultimate effect of couple miniaturization is illustrated in Fig. 3. The curves shown are for $Z = 3 \times 10^{-3}\ C^{-1}$, identical with the curve shown in Fig. 1 together with two additional curves, Z = 3 (limit) and Z = 10 (limit), which are manufacturing cost curves with TE material costs reduced to the vanishing point. Thus these curves may be said to represent the ultimate attainable for these respective Z values, but certain reservations should be stressed. In particular, it should be emphasized that these curves do not consider possible power supply cost reductions. Some cost reductions are undoubtedly possible within the framework of conventional design; however, radically new concepts may also have an important effect upon costs. For example, the introduction of the fuel cell, essentially a low voltage, high current dc generator, as a primary source of power in the home and which might well be feasible within the next five years, would enhance, considerably, the competitive position of thermoelectricity for refrigeration and heating.

Because some degree of couple miniaturization can be considered feasible today, it is estimated that thermoelectric refrigeration can now be considered competitive with the mechanical systems for capacities up to 300 Btu/hr. When Z reaches $5 \times 10^{-3}\ C^{-1}$ the TE system will be competitive up to 500 Btu/hr.

The progress in thermoelectricity with regard to applications can therefore be summarized as shown in Fig. 4. From this it would seem inevitable that if the present rate of progress continues as is anticipated, thermoelectric refrigeration will move into the appliance area sooner than had been expected previously and probably in the near future.

Fig. 3 Effect of thermoelectric couple miniaturization on manufacturing costs

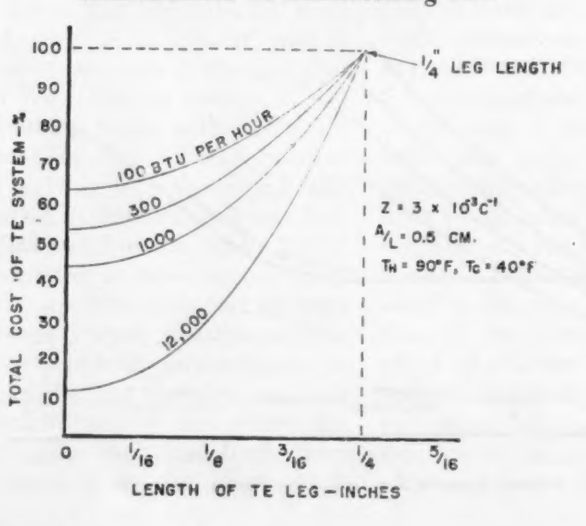
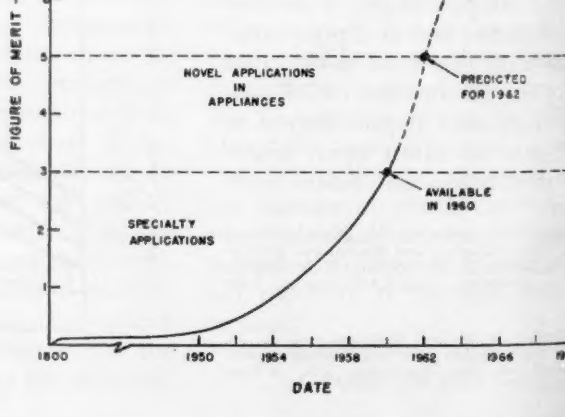


Fig. 4 Progress in thermoelectric refrigeration



Past-President Arthur Cutts Willard 1878-1960

Honorary Member of the American Society of Heating, Refrigerating and Air Conditioning Engineers, Past-President of precedent American Society of Heating and Ventilating Engineers (1928-29), 1936 recipient of the F. Paul Anderson Award, University of Illinois President Emeritus and one of the nation's leading heating, ventilating and air conditioning engineers, Arthur Cutts Willard died in Urbana, Ill., on September 11, 1960, following a heart attack.

Dr. Willard went to the University of Illinois in 1913 as Assistant Professor of Heating and Ventilation, advancing to a full professorship in 1917 and becoming Head of the Mechanical Engineering Dept in 1920. In 1933-34 he was acting Dean of the College of Engineering and Director of the Engineering Experiment Station. It was from this post that he rose to the presidency in 1934. He had been President Emeritus since 1946. Since his retirement, Dr. Willard had retained his interest in activities of the University, continuing to serve as a valued counsellor.

Dr. Willard preceded his 33-year career with the University by entering the teaching profession as an instructor in industrial chemistry at California School of Mechanical Arts, following his graduation (in 1904) from Massachusetts Institute of Technology. In 1906 he was appointed Assistant Professor of Mechanical Engineering at George Washington University, leaving in 1909 to join the United States Quartermaster Corps, where he served until 1913.

Born August 12, 1878, in Washington, D. C., he was the son of Alexander D. and Sarah (Cutts) Willard. Originally intending to be a pharmacist, he entered the National College of Pharmacy in 1898, later turning to engineering and enrolling at Massachusetts Institute of Technology, where he received the degree of B.S. in chemical engineering in 1904. In 1934 he was awarded the degree of Doctor of Engineering from Case School of Applied Sciences in Cleveland and honorary Doctor of Law degrees from George Washington and Northwestern Universities. The Universities of Illinois and Maine conferred honorary Doctor of Law degrees on him in 1946 and 1947, respectively. In 1907 he married Sarah Lamborn, who survives him.

In his long (since 1914) affiliation with ASHRAE and precedent ASHVE, he has served in many capacities, including the offices of 2nd Vice President (1926), 1st Vice President (1927) and President (1928). From 1925 to 1929 he was a member of Council. ASHVE representative on the National Research Council for a three-year term, he was also a member of the Committee on Research and subsequently Technical Adviser and Chairman of the Committee on Research Fund Raising; Chairman of the Guide Publication, Executive, Publication and Program Committees; and a member of the Committees on Ventilation Standards and Code of Minimum Requirements for Heating and Ventilation of Buildings. He was made a Life Member in 1944; an honorary member in 1956.

Chief among his many published writings are three books, on which he collaborated with L. A. Harding, "Mechanical Equipment of Buildings", Vols. I ("Heating and Ventilation", 1916, revised 1929) and II ("Power Plants and Refrigeration", 1918), and "Heating, Ventilating and Air Conditioning" (1932).

A specialist in the fields of heating, ventilating and air conditioning, Dr. Willard was consulting engineer for New York City's Holland Tunnel, the U. S. Capitol, U. S. Bureau of Mines, U. S. Public Health Service and the Chicago subway system. Leader of research teams which developed guiding principles for today's domestic furnaces and air conditioning and a collaborator with medical scientists in pioneering investigation of atmospheric environmental influences on mankind, he was a pioneer in warm air furnace heating research and, through his untiring efforts, a residence for research purposes was constructed at the University of Illinois. Dr. Willard's contributions to the fields of heating, ventilating and air conditioning, both directly in services rendered and indirectly through his former students, associates, research activities and writings, are literally innumerable.

PRESIDENT'S PAGE
JOHN E. DUBE
Guest Sponsor

ASHRAE Budgeting is

After a period of deficit spending, our merged Society is now operating on a balanced budget.

The following table compares actual operating performance during the fiscal year 1959-60 with the budgeted forecast for this fiscal year.

	1959-60 Actual	1960-61 Budget Revised 10-15-60
Operating Income		
Dues	$ 423,000	$ 432,000
Publications	471,000	552,000
Exposition, Emblems, etc.	56,000	80,000
Research	59,000	64,000
Total	1,009,000	1,128,000
Operating Expense		
Committees and Chapters	$ 93,000	$ 97,000
Meetings	21,000	18,000
Publications	392,000	420,000
Headquarters	429,000	361,000
Research and Research Promotion	213,000	210,000
Total	1,148,000	1,106,000
Excess of Income Over Expenses	(139,000)	22,000

Last year we experienced an operating deficit of $139,000, which was reduced to a net deficit of $101,000 by admission fees, interest and investment income. This $101,000 was financed from members' equity and is reflected in the shrinkage of the balance of our consolidated funds from $770,000 to $669,000.

Although no one expected to operate in the black before the present fiscal year, you might properly ask what caused this 14% deficit. Again the answer can be found in the tabulation.

It is obvious that we did not obtain sufficient publication income last year. This disappointing result reflects insufficient advertising revenue from the JOURNAL. Important ground was lost, due to a necessary reorganization of the Advertising Department in the middle of the year. This year is definitely getting off to a better start, since we are now profiting by last year's corrective actions. On the expense side, "Headquarters Expense" was too high due to non-recurring merger expenses as well as a reasonable delay in curtailing the headquarters staff. The present 54 staff positions correspond to the number recommended in the Report of the Merger Committee of January, 1958.

This year's budget reflects both a reduction of expenses and an increase of income over last year. Although it would not be prudent to guarantee the actual realization of the budgeted surplus this early in the fiscal year, we can promise with reasonable confidence that we will end the year in the black. The most substantial increase of income must come from our publications, particularly from JOURNAL advertising. In this department we have set for ourselves a realistic but difficult goal. If you are contacted by one of our hard-working advertising space salesmen, please give him a hand!

As can be seen in the tabulation, last year's income from publications exceeded publication expenses by $79,000. The equivalent budgeted publication surplus for this year amounts to $132,000. However, these figures are misleading since they do not reflect the salaries and expenses of the staff personnel which is responsible for the publications. These items continue to be included in "Headquarters' Expense." I have attempted to segregate thèse expenses, salaries, rent, light and other office expenses, only as they apply to the persons directly responsible for the publications. With the application of this correction, last year's Publications Surplus would have turned into a loss of $47,000, distributed as follows: the JOURNAL just broke even despite low advertising income; loss on the GUIDE was $8,000; Standards, Reprints, etc., accounted for a $10,000 loss, but the lion's share, namely, $29,000, was occasioned by TRANSACTIONS. That is why the Board of Directors has approved a nominal charge for TRANSACTIONS in the future.

Although we are now operating on a balanced budget, I do not want to leave the impression that we have solved adequately all financial problems of the Society. There are several important expense items which we can not as yet include in our budget. For example, the Board of Directors decided at the last annual meeting in Dallas that four additional committees should be

is Balanced

JOHN E. DUBE
Treasurer
ASHRAE

entitled to reimbursement of travel expenses at such time as the Finance Committee felt the Society could affort it. No allowance for such expense is included in this year's budget. It would be desirable to be in a position to reimburse members of all committees for travel expenses, if they so desired.

This policy would ensure productive use of all the talents of our membership, regardless of ability to absorb financial burdens. Although this year we have budgeted the considerable sum of $43,000 for Board and Committee travel, we could not include any allowance for the four additional committees recommended by the Board. Despite this undesirable situation, a recent survey revealed that we compare quite favorably with other technical societies in regard to travel reimbursement of members working on behalf of the Society.

Another expense item which should be included in future budgets is a Reserve for Pensions for employees who were past the age of 55 when our present pension plan was established. Pensions for these employees will some day become an operating expense, and consequently a Reserve Fund should be established as soon as possible. Our reserves have been reduced by the cost of the merger; they will probably be reduced more next year when we will have to meet the cost of moving into new quarters in the United Engineering Building. Consequently, in the future we should budget a more substantial surplus, not only to replenish our reserves, but to enlarge them considerably. A well financed society should have a minimum reserve of one year's expenditures. Out of our Consolidated Fund Balance of $669,000 we have only $360,000 in the Society Reserve and the Research Reserve Funds. By any conservative standard this is not adequate for a Society operating on an annual budget in excess of one million dollars.

Obviously it takes years to establish such a degree of financial security, however, in the meantime each member can help to improve the financial strength of our Society by close attention to the following three points:

Help to increase membership.

Encourage advertising in our publications.

Promote support of the Research Fund.

COMMITTEE ACTIONS

ASHRAE TO CO-SPONSOR THERMOELECTRIC SYMPOSIUM

Everett P. Palmatier, Chairman of the ASHRAE Research and Technical Committee, has announced that the U. S. Department of Defense and a number of technical societies, including ASHRAE, are sponsoring a symposium on Thermoelectric Energy to be held on January 8-12, 1961, at the Statler-Hilton Hotel in Dallas. ASHRAE participation will be directed by Technical Committee 1.4 on Thermoelectricity, chairmaned by E. R. Wolfert. G. D. Hudelson, a member of TC 1.4, will be the ASHRAE representative on the Program and Publications Committee of the symposium.

The symposium is being held in realization of the interdisciplinary nature of the technical problems associated with direct energy conversion and the need for communication among members of the several technical societies and between industrial, university, and military programs. This is to be an open technical meeting. Among the topics to be discussed are: Related Aspects of Direct Conversion; Physical Theory; Synthesis and Evaluation of Thermoelectric Materials; Environmental Effects; Materials Fabrication and Assembly; Methods of Measurement; Design Parameters; and Device Construction and Performance.

Society members interested in attending the symposium may obtain copies of the program announcement and hotel reservation forms from A. T. Boggs, III, Technical Secretary, ASHRAE. Headquarters, 234 Fifth Avenue, New York 1, N. Y.

AGA again Emphasizes Research

Authoritatively plugging the now well-established AGA theme of research and more research, James M. Gavin, President of Arthur D. Little, Inc., keynoted the General Session of the 1960 Convention of the American Gas Association in Atlantic City last month. Opportunities in Research was the title of General Gavin's talk, but he soon turned this toward the indispensability of research to industry, to management, and to survival.

As cited by General Gavin, an estimated $80 billion has been expended in this country from the days of the first colony until the present upon research, but $70 billion of this has been within the past 10 years. As a result, not only has the entire attitude and aspect of industry been altered, but a round of activity has been initiated to which there can be neither interruption nor cessation. "Indeed," said the speaker, "basic research is basic to everything that comes hereafter . . . management must and can only make decisions on the basis of adequate facts . . . it is easy to cite the industries that have fallen by the wayside because they did not undertake adequate research."

FIVE-STEP RESEARCH

There are just five parts of a true research program, according to General Gavin, involving diversification (but this is not alone an assurance of success), research for obsolescence (but not research for research alone), avoidance of pedestrianism, prevention of research stalemates (bringing in outside talent to critically examine the work and findings of insiders), and continual entrance into new areas with the objective of not only getting there but staying there. As of special interest to ASHRAE, General Gavin stated, "Cryogenics is the heart and soul of space technology," and as an answer to the question of why should we go to the moon, he offered the conclusion that we would learn so much about other things, of more immediate interest and applicability, in planning about moon and other space ventures.

Emphasizing other aspects of the problem concisely and dynamically, General Gavin provided such observations as, "The United States is in danger of losing its science leadership within 10 years . . . we must support a dynamic, aggressive research program for survival" and "God help America to do its needed best."

OTHER OPPORTUNITIES

In the course of the business sessions of this October 10-12 Convention, other opportunities were emphasized, too. These were for greater understanding, for greater sales and for better management. Speakers included President Wister H. Ligon of the American Gas Association, Wendell C. Davis, President of the Gas Appliance Manufacturers Association, and Martin L. Bartling, Jr., President, National Association of Home Builders.

Customary recognition of safety, operating, management, public relations, and industry accomplishments was afforded by various awards presented at the General Session.

AT THE EXHIBIT

Presented in the Atlantic City Convention Hall was an elaborate and highly dramatized exhibit of equipment and facilities of the gas industry as related to both components of operating systems, to consumer products, and to the research efforts of individual gas companies. Still keyed to the research theme, emphasis was placed upon both that which was new and that which had significance.

Among more than a score of displays with definite implications of an advanced present and an exciting future was a fuel cell producing electricity from gas and oxygen without heat and a thermionic generator. A thermocouple application showed an electric heater with accompanying fan, the latter being supplied by electricity derived solely from the heater. A prototype range-water heater combination was on display as was a "flameproof" pilot lighter, subject neither to extinguishment nor failure to relight automatically. Two gas air conditioners in prototype form were shown, both based upon natural gas-fired motors to operate the refrigerant compressor system. One unit was air cooled, the other used a liquid coolant relating to the heat pump.

Gas burners powered by invisible flames were emphasized, too. One of them, termed a thermocatalytic burner and producing energy by the combustion of a gas-air mixture inside a tube or coil completely enclosing the flame, is said to provide operating efficiencies up to 98%, and savings of fuel cost in the range of 30 to 40%. There were a number of products and applications involving infra-red equipment.

Summarizing progress, President Ligon observed that AGA last year spent $2 million on research and that the average annual expenditure during the current decade would be more than double that figure. He pointed to fuel and gas equipment sales in the past decade of $46.5 billion, to a gross plant value of $20 million, and to reserves at the end of 1959 of 262.6 trillion cubic feet with a net production of 12.4 trillion cubic feet during the year.

Nominations

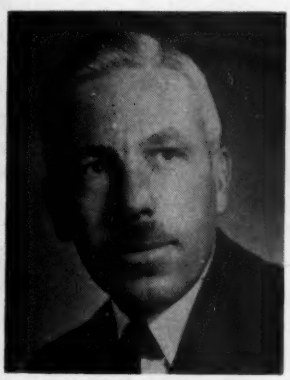
John H. Fox for Second Vice President

John E. Dube for Treasurer

Officer succession for the February 1961 to June 1961 interval being provided by the Agreement for Consolidation, and membership of the remainder of the Board of Directors being established until June 1961 by the content of the present Board, the Nominating Committee has but two selections to announce presently. These are John H. Fox for Second Vice President and John E. Dube for Treasurer.

Your Nominating Committee, whose Chairman is C. M. Ashley, consisted of R. M. Westcott, S. F. Gilman, Charles Torry, W. A. Siegfried, R. K. Rouse, L. C. Burkes, D. S. Falk, D. M. Mills, F. R. Denham, J. K. James, C. L. Hall, R. A. Baker, J. R. Caulk, Jr., H. G. S. Murray, P. N. Vinther, R. A. Sherman and B. W. Farnes.

FOR SECOND VICE PRESIDENT, FEBRUARY 1961 – JUNE 1961: JOHN H. FOX



JOHN H. FOX

Vice President of Honeywell Controls, Ltd., the Vice Presidential nominee has been a member of the Society since 1935, when he joined the former ASHVE. Treasurer of ASHAE in 1958, he served on the Council from 1951-56 and was Regional Director of Region VII in 1956. Affiliated with Ontario Chapter, he was a member of the Board of Governors from 1938-39 and 1946-48, Vice President in 1949 and President in 1950.

National activities in the former ASHAE have included membership on the following committees: Chapter Delegates, 1949; Chapters Conference, 1950 and 1952; Chapter Relations, 1950 and 1955; Membership, 1954; Special Committee to Codify Council Policies, Chairman, 1954-55; and Public Relations, Chairman, 1955-56. In 1958 Mr. Fox served as a member of the Executive Committee of the ASHAE Council and as ex officio member of the Finance Committee.

Since the merger, he has been 1st and 2nd Treasurer, Chairman of the Finance Committee and a member of the Heating Section of the Divisional Advisory Committee. He is currently serving a term as Director-at-Large and is a member of the Honors and Awards Committee and Chairman of the Divisional Advisory Committee.

FOR TREASURER, FEBRUARY 1961 – JUNE 1961: JOHN E. DUBE

President of Alco Valve Company, with which he has been associated for more than 20 years, he is a graduate of the University of Cincinnati. Numerous papers and articles written by him have appeared in various technical publications and been read before local chapter meetings.

Joining the former ASRE in 1940, the Treasurer-nominee has participated as a Director of Council, 1958-59, and served on the Industrial Relations (Chairman), International Affairs and Research Exhibits Committees, in addition to being Regional Director for Region IX, 1955-58.

ASHRAE activities since the merger include membership on the Board of Directors; Exposition, International Relations, Finance (current Chairman), Research Fund Raising (past-Chairman) and Advertising Committees. He is currently serving a term (from June 1960 to January 1961) as Treasurer of the Society and is Chairman of the Finance Committee. His local affiliation is with the St. Louis Chapter, of which he is past-Chairman.

JOHN E. DUBE

	Quota	Subscription	Quotas Remaining
ASCE	$ 800,000	$ 814,596.22	$ . . .
AIME	500,000	411,161.90	88,838.10
ASME	800,000	709,221.03	90,778.97
AIEE	900,000	849,370.84	50,629.16
AIChE	300,000	318,926.70	. . .
AICE	25,000	25,018.33	. . .
AIIndE	70,000	73,874.53	. . .
SWE	7,000	4,944.50	2,955.50
AWS	60,000	31,127.10	28,872.90
ASHRAE	**250,000**	**26,523.50**	**223,476.50**
IES	75,000	13,382.48	61,617.52
Others	13,000	18,765.54	. . .
	$3,800,000	$3,296,012.67	$547,168.65

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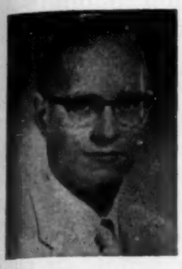
The status of ASHRAE's UEC Fund Raising Campaign as of September 30 is quite poor, as compared with that of the other participating societies. ASHRAE needs the support of all its members. Thus far, only two chapters have achieved their quotas. Please send in your pledge TODAY!

Acoustical systems determine

Oil burner pulsations

and their amplitudes



C. F. SPEICH

A. A. PUTNAM

Pulsations in oil-fired equipment have long been a source of annoyance to the heating industry and its customers. Through the trial and error of past experience and limited research, a number of techniques have been devised which may suppress the occasional pulsations found in service units. However, the techniques are not uniformly effective. Thus, a measurable amount of industry effort is expended annually, either directly or indirectly, for the suppresssion of pulsations. As a result of the need for a more fundamental understanding of the mechanism of pulsations in oil- and gas-fired residential heating equipment, as well as the need for more effective suppression techniques, three sponsoring groups* initiated a research project at Battelle Memorial Institute. This paper, one of a series resulting from this program, covers the proposed mechanism of pulsation in oil-fired units. A subsequent paper will discuss suppression techniques for the same class of units.

The paper is divided into three main sections: (1) a summary of the studies of furnace and burner variables which were investigated as part of the program to determine which factors were important to the generation of pulsations, (2) a discussion of the mechanism of pulsation, and (3) concluding remarks regarding the consequences of these studies.

FURNACE AND BURNER VARIABLES

Before discussing the experimental data concerning the effect of various furnace and burner variables on the pulsation amplitude, a short description of the procedure and equipment used for these studies is given.

Research Procedure and Equipment—In the beginning of this research program, a series of systematic studies on furnace and burner variables, using one experimental and several commercial furnaces, was made to determine how each affected the amplitude of pulsation. Different burners having solid and hollow air patterns were fired in the experimental furnace.

Fig. 1 presents both sectional and external views of the experimental furnace built in the early part of the program and used for most of the subsequent investigations. This axially symmetric furnace was designed to have a firing capacity of 0.85 to 1.00 gph. The internal simplicity of the furnace made it easier to calculate such factors as the natural acoustic frequencies of the furnace-burner system.

The Variables—Table I summarizes the effect of each of the furnace and burner variables studied in this and previous research programs. The Table is divided into two parts: (A) those variables which had an important effect on the amplitude, and (B) those which had little or no effect. Whenever possible, the effect of one variable was evaluated while all others were held constant.

It is seen from this table that the fuel spray, air, and recirculation patterns are the variables which are important to the generation of pulsations. Other variables such as draft, fan characteristics, and furnace configuration within normal limits have little effect on the generation of pulsations. The table indicates only the principal

Sixth in a series of related studies of oil- and gas-fired residential equipment, this analysis of burner pulsations and their amplitudes leads to these conclusions—

- Pulsations result from acoustical phenomena
- Acoustical systems determine the frequency and amplitude
- Mechanisms of pulsation are oscillations of acoustical pressures and periodic rate of heat release.

*The sponsoring groups of this project were predecessor American Society of Heating and Air-Conditioning Engineers, Inc., the Oil-Heat Institute of America, Inc., and the American Gas Association.

A. A. Putnam and C. F. Speich are with the Battelle Memorial Institute. This paper has been prepared for presentation as "Combustion-driven pulsations in oil-fired residential heating equipment" at the ASHRAE Semiannual Meeting in Chicago, Ill. February 13-16, 1961.

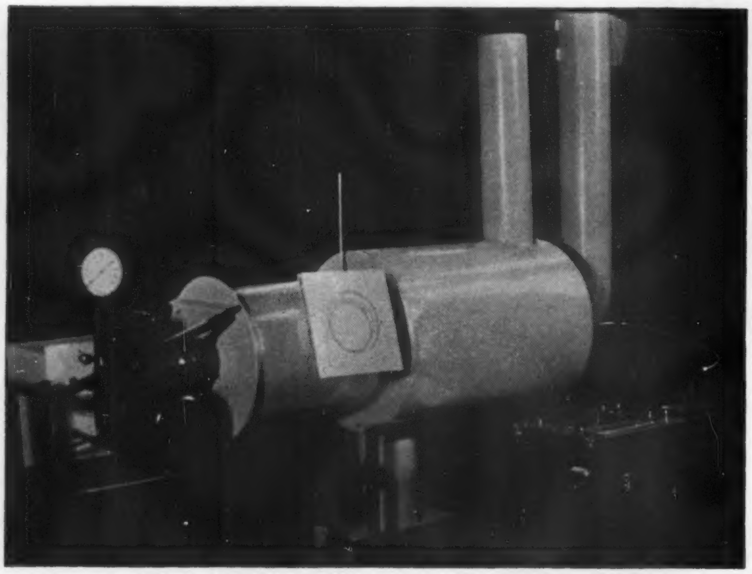
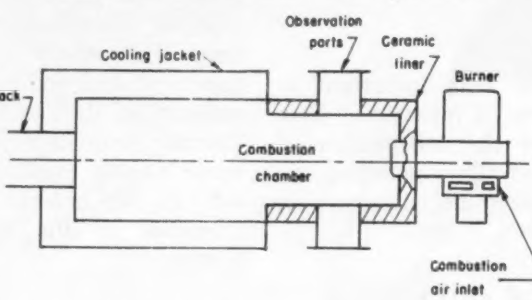


Fig. 1 With this facility Battelle researchers studied oil furnace flame pulsations



items which were studied in this and other programs. Investigations of other variables have been reported in the literature. However, since they have been found to have an insignificant effect on the pulsation amplitude when all other factors are held constant, these variables have been excluded from the table.

Fig. 2 summarizes the general results reported[1] for a burner with a solid air pattern. In the initial studies, the principal emphasis was placed on the effect of spray pattern on the amplitude of pulsation, because the spray pattern was both easily changed and had been found to have a significant effect.

It was found there were two ranges of pulsation, a high-amplitude range and a low-amplitude range. In each range, the amplitude gradually diminished as air-fuel ratios were increased. However, as the mixture was changed from rich to lean, the amplitude changed suddenly from low to high; then, after a further increase in air-fuel ratio, the amplitude dropped back to a low level. The mixture at which these rapid changes in amplitude occurred was found to be a function of the mean fuel-spray angle.*

Fig. 2 represents a composite of the data for a number of different nozzle angles and types, and therefore covers a wide range of air-fuel ratios. With any specific nozzle and a reasonable operating range of air-fuel ratios, only part of the total pattern would be evident. Hence, for one nozzle, only the amplitude pattern around the rich transition point might be observed; for another, only the amplitude pattern around the lean transition point would be evident. This indicates the apparent contradiction encountered by many servicemen in attempting to eliminate undesirable pulsations by air adjustment alone; it is seen that it is possible to avoid pulsations in some circumstances by an increase in air-fuel ratio, and in other circumstances by a decrease in air-fuel ratio.

When the amplitude studies were extended to other burners having hollow air patterns, it was found that the results were similar, but not identical to those found with burners having solid air patterns. The observed effect on the rich-side transition points was found to be essentially the same, regardless of air pattern, for comparable changes in the mean fuel-spray angle. On the lean-side transition point, the transition point was found to move to leaner mixtures for increases in mean-fuel-spray angle when the air pattern was solid, but for hollow air patterns, the reversed trend was found to exist.

The effect of changes in the recirculation pattern in the combustion chamber was quite difficult to define in a manner that would lead to definitive results. However, two observations are worthy of mention. It was revealed that projecting the blast-tube exit into the combustion chamber increased the amplitude of pulsation. The results of a previous investigation[2] had shown that placing a disk on the axis of a combustion chamber, at the proper distance from the nozzle, also increased the amplitude of pulsation. It is concluded that the influence of both of these changes was felt primarily in the recirculation zone, and that the flow in this zone could affect the pulsation amplitude.

It was observed during this program that the pulsation amplitude was not the same among the various burners studied. Consideration of the available information indicated a correlation could be made between these changes in amplitude and the measured differences between the various natural frequencies of the entire furnace-burner unit and the single natural frequency of the burner considered separately. The difference in natural frequency, as well as any change which might occur in the specific mode of oscillation of the gases within the combustion chamber and blast tube, would affect the periodic flow pattern in the combustion region near the blast-tube exit, if the furnace-

* In the analysis of the fuel-spray pattern data, it was found convenient to replace the nominal designation of fuel sprays, namely, spray angle and pattern, with a hypothetical spray-pattern model. This model defined all sprays, regardless of angle or pattern, as a thin, hollow spray in which all of the fuel was concentrated at some effective angle. The model's effective angle of spray was defined, mathematically, as the mean angle of mass concentration of the original spray and was calculated in a manner similar to the determination of the center of gravity for a linear distribution of masses.

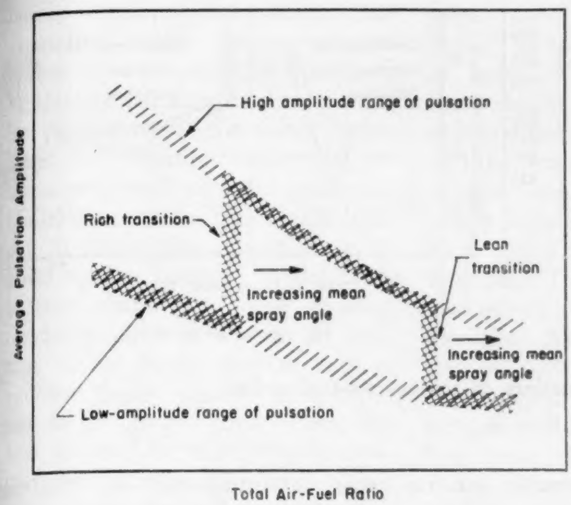


Fig. 2 How low- and high-amplitude ranges of pulsation related to a solid air pattern and typical amplitude observations for one nozzle

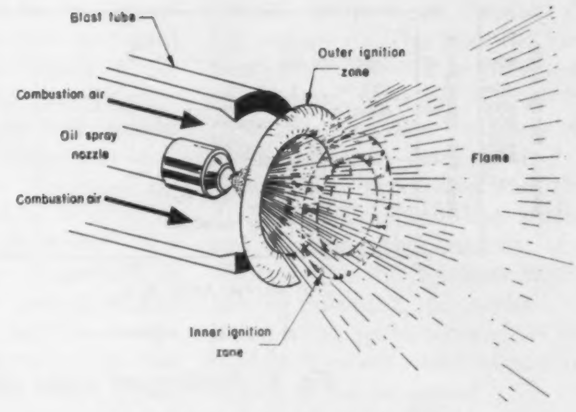


Fig. 3 Regions of periodic ignition

burner natural frequency remained essentially constant. Hence, the coupling between the acoustical system and the combustion system would be changed, thus changing the amplitude of pulsation. This argument follows closely the principle outlined in a previous discussion of the mechanism of oscillation in gas-fired multiple-port burner-heating units.[3]

Research during the early part of the program brought to light the potential problem of room acoustics.[4] It was determined that under certain conditions, the room which encloses the heating unit, or any room in the residence, can amplify a specific frequency of the noise from the heating unit, thereby making a normally quiet unit appear to be objectionally noisy. Remedial techniques for this are outlined in Reference 4.

PULSATION MECHANISM

From the results of the studies of furnace and burner variables, it has been possible to postulate a mechanism by which pulsations in oil-fired heating units are generated. This mechanism can perhaps best be understood if consideration is first given to the physical occurrences within the combustion chamber during pulsating and nonpulsating conditions.

A violently pulsating flame in an oil furnace will often appear to the unaided eye as a steady flame with some suggestion of a periodic flicker. Therefore, to study the actual movements of the flame front, it was necessary to use high-speed movies to "slow down" the flame movements. Many movies were taken of the flames of different burners, under different conditions of pulsation and nonpulsation. When the processed films were viewed at roughly 1/50 true speed, the cyclic events of the flame front became evident.

For nonpulsating conditions, the flame was initiated, even with the ignition off, at a constant distance downstream of the blast-tube exit, and combustion was continuous. Under pulsating conditions, the high-speed movies showed that combustion was not continuous, and, thus, that the position of the flame front was not constant.* Instead, the flame appeared to be initiated within the blast-tube exit or downstream from it and to expand rapidly as the gases passed downstream. Later in the cycle, luminous gases were seen in some furnace configurations to recirculate back to the blast-tube exit from regions downstream of the usual flame region to ignite the next batch of combustible mixture. In other cases, there was no visible recirculation of luminous gases; under these conditions it was surmised that hot, nonluminous gases were the means of periodic ignition.

Pressure measurements within the combustion chamber during pulsation indicated that there is an alternating acoustic pressure which is synchronized with the flame discontinuities. The amplitude of these pressure changes is such that it affects the capacity of the blower. When the pressure is low, a low pumping head is presented to the blower and an increasing flow rate of air results. With a constant fuel-flow rate, a large flame is produced by the sudden excess supply of air into the temporary fuel-rich atmosphere of the combustion chamber. The hot gases from this flame build up the pressure within the combustion chamber, causing the pumping head of the blower to increase, and thus producing a corresponding decrease in air-flow rate. The decrease in air flow "starves" the flame for air and a smaller quantity of hot gases is produced. As a result, the pressure in the combustion chamber drops and the cycle is repeated. It is this alternating pressure that is called pulsation.

Of primary interest to this study was the determination of the manner in which the furnace and burner variables interact to sustain pulsations. As a first step in this determination, a theory on the driving of oscillations by combustion, based on Rayleigh's criterion,[5] was applied. In summary, Rayleigh hypothesized that a heat-driven oscillation could be sustained if a pressure oscillation was kept in phase with a periodic rate of heat release so that the maximum rate of heat release occurred when the acoustic pressure was above the average pressure. Note that two phenomena are involved: an acoustic pressure oscillation and

* Prints from such a movie presented in a previous paper[1].

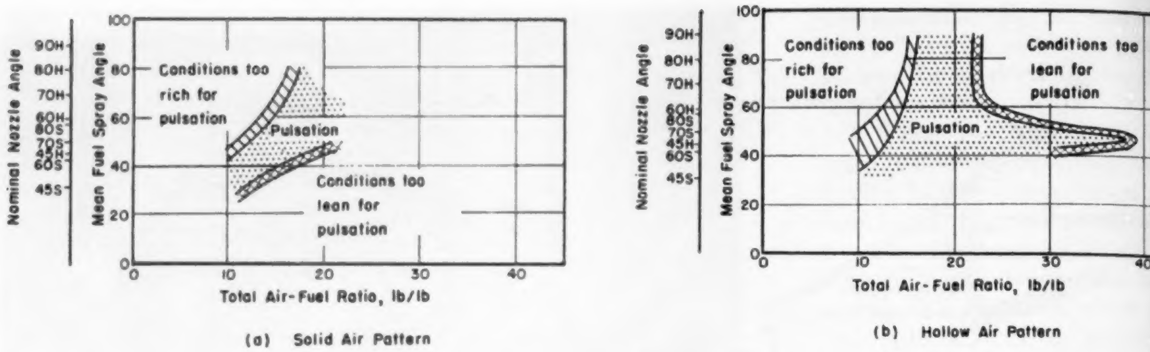


Fig. 4 Nozzle-spray angles affect pulsations at various air-fuel ratios

a periodic rate of heat release. If either one of the phenomena could be eliminated, or if the phasing between them could be changed, then the pulsation could be eliminated. Each phenomenon will now be considered separately so that the furnace and burner variables which affect each of the phenomena can be understood better.

Pressure Oscillation – The characteristics of the pressure oscillation, which is considered in Rayleigh's criterion, are determined by a resonance condition in the furnace-burner system which is composed of a combustion chamber coupled with the burner on one end and a stack on the other. These components form, acoustically, a resonant system which has several natural frequencies. Although the flame within the combustion chamber produces noise over a wide range of frequencies, the furnace-burner system amplifies only those frequencies which are equal to the natural frequencies of the system. This flame noise is characterized as being a complex wave made up of a number of frequencies, all of which have low amplitudes, as contrasted to pulsation which is characterized by a single frequency of high amplitude.

Frequency measurements which were made of the noise from the experimental furnace during combustion conditions indicated that the frequency of the pulsation was usually about 32 cps. Acoustic measurements were made for "cold" conditions, without combustion, to determine the natural frequencies of the various components singularly and in combination. These natural frequencies were used to calculate the theoretical natural frequencies for the different burner-experimental furnace systems used during this program. Without combustion occurring, it was determined by calculation that the experimental furnace and a burner with a typical shutter-controlled blower inlet had two natural frequencies of practical interest. One of these frequencies was between 21 and 30 cps, and the other about 10 cps higher.

Periodic Heat Release – Periodic heat release results from periodic ignition of the combustible mixture. The factors which affect this periodic ignition are obviously the fuel-spray pattern, the air pattern, and the pattern of the recirculated hot combustion products. High-speed movies of the flame indicate that, during conditions of high-amplitude pulsation, the ignition of the combustible mixture occurs only in two doughnut-shaped regions of the combustion chamber and thus it is the quantity of fuel, air, and recirculated products within these regions which are important to the generation of pulsation rather than the average conditions of the entire combustion chamber.

Fig. 3 shows these ignition regions. An inner ignition zone was observed somewhat downstream to the blast-tube exit, near the burner axis, and within the fuel-spray cone. An outer ignition zone was considered to be concentric with the inner zone but closer to the blast-tube exit and outside of the main cone of fuel spray.

For some of the high-speed movies, a special technique was used by which a signal, indicative of the oscillating pressure amplitude in the combustion chamber, was superimposed on the film simultaneously with the exposure of the flame photographs. In this manner, the phasing between the ignition and the pressure amplitude could be determined. The ignition in the inner region occurred at about the time the oscillating acoustic pressure was at a minimum, and in the outer ignition region, by the proper combination of conditions, when the pressure was at a maximum. However, it is not the ignition of the combustible mixture, but rather, the maximum rate of heat release which supplies the energy for driving the pulsation. There is a time lag from the occurrence of ignition to the attainment of this maximum rate of heat release. If this time lag is of the order of one-half of the period of the pulsation, it would appear from Rayleigh's criterion that pulsations would be driven from the inner ignition region when the proper mixture of fuel, air, and hot gases was available.

Based on the same value of time lag, a continual expansion of the flame from the outer ignition region would place an energy input in the wrong phase with the oscillating pressure to drive a pulsation. Consequently, in a system where both inner and outer ignition are occurring, pulsations which were driven by ignition and flame expansion from the inner region could actually be damped out by the outer ignition. But fuel is not available ordinarily in the outer region for such continual expansion.

It is possible, however, to drive a pulsation from the outer ignition region in the following manner. As observed in high-speed photographs for certain

burner-furnace combinations, the expanding outer flame can be broken up and partially quenched by the reverse flow, and may even be pushed into the blast tube. Then the burning remnants are again projected into the combustible mixture as the gases rush back out, at above the average rate, to build up the pressure in the combustion chamber. These burning remnants serve as sources of ignition in the inner ignition region, and the flame expands at a rapid rate at the proper time. Thus, the heat needed for the periodic ignition can actually arise from either flame remnants or from hot gases.

In order for ignition to occur in either the inner or outer ignition zone, a combustible mixture of vaporized fuel, air, and recirculated products must be present. The rate of heat release by the flame in these zones is controlled by the local air-fuel ratio in each zone. When the local air-fuel ratio is close to stoichiometric, the rate of heat release will be a maximum. If a sufficient deviation is made from this mixture, heat may be released at a lower rate so that not enough heat will be released in phase with the acoustic pressure oscillation to sustain the pulsation. Changes in the local air-fuel ratio can be brought about by variations in the fuel spray, air, and recirculation patterns. Factors which affect each of these variables will now be discussed briefly.

Fuel-Spray Patterns — There are three factors which control the quantity of fuel available for combustion in the ignition regions and thus control the rate of heat release. These factors are the (1) distribution of fuel droplet sizes, (2) heat available to vaporize the fuel, and (3) fuel-spray angle and pattern.

It has been shown by Binark and Ranz[6,7] that the distribution of fuel-droplet sizes within a hollow spray exhausting into still air is partially determined by the induction of air by the fuel spray. Small droplets were found to be swept into the interior of the spray near the nozzle; these droplets were found near the spray axis. The larger droplets, which were swept into the spray interior further downstream from the nozzle, were found closer to the spray shell. The forced-air systems found in actual burners would affect these results, but the same relative segregation of droplet sizes would still be expected; thus, the fuel-droplet sizes within the inner ignition region would be conducive to a rapid evaporation and easy ignition. The ease of ignition is also affected by the amount of heat available. As has already been suggested, this heat comes from the recirculated hot-combustion products as well as from radiation from the flame and containing furnace walls. The fuel-spray angle and pattern also affect the availability of fuel in the ignition regions as has been summarized in the discussion accompanying Fig. 2.

Air Pattern — Different burners produce air patterns ranging between a solid and a hollow cone. Furthermore, the pattern tends to change with air-flow rate, especially the hollow air patterns. The shape of the pattern will determine how much air is made available in the ignition regions to burn the fuel.

Unlike the fuel-spray pattern, the air pattern is not constant during pulsation. The periodic variation in velocity will produce a corresponding variation in air-flow pattern. The flow pattern will form and then tend to collapse periodically, producing and shedding large doughnut-like vortices, and changing the quantity of air available in the ignition regions. During pulsation, this periodic variation in air pattern could set up a feed-back effect which would help to lock in the pulsation.

Recirculation Patterns — Recirculation, which is set up by the momentum of the air and fuel streams, is a natural phenomenon within the combustion chamber. Hot combustion products are returned to the flame region by the large recirculation loops. As with the air pattern, the presence of pulsations can affect the quantity of hot products which enter the ignition region to ignite the mixture.

Regions of Pulsation—The effects of the fuel spray, air, and recirculation patterns are interrelated so that in an actual burner system it is probably impossible to com-

TABLE I

SUMMARY OF THE EFFECTS OF VARIOUS FURNACE AND BURNER VARIABLES ON THE AMPLITUDE OF PULSATION

Variable	Effect
A. Variables having an important effect on the amplitude	
Fuel spray (angle and pattern)	— high- and low-amplitude levels were found (Fig. 2); air-fuel mixtures at which transitions occurred were found to be a function of fuel-spray angle
Air pattern	— affected the mixtures at which the transitions occurred
Recirculation pattern	— certain changes in the recirculation pattern were found to increase the amplitude
Acoustical characteristics of the blast tubes	— can either increase or decrease amplitude depending on the natural frequency of the furnace-burner system and the mode of oscillation
B. Variables having little or no effect on the amplitude	
Continuous ignition	— reduced the amplitude slightly in most cases
Burner fan characteristics	— can lend instability to the burner-furnace system
Draft	— affects the acoustical system by changing the natural frequency and the acoustic losses
Frequency	— transition points did not occur at a constant frequency
Furnace configuration	— can affect recirculation patterns, acoustic losses, or natural frequencies
Atmospheric conditions	— unknown

pletely separate the effect of each variable on the presence of pulsation. However, during the course of the experimental studies conducted during this program, it was possible to define over-all conditions of pulsation and nonpulsation for the burners used even though the different variables were known to affect each other.

Fig. 4 is a map of pulsating and nonpulsating regions in terms of the mean fuel-spray angle, the total air-fuel ratio, and the air pattern as determined with the experimental furnace and burners described earlier. For each air pattern, it was found that pulsations occurred for certain ranges of air-fuel ratio and mean fuel-spray angle. In the case of the solid air pattern, a sufficient decrease in total air-fuel ratio and an increase in the mean fuel-spray angle caused the pulsations to cease, probably because the local air-fuel ratio in the ignition regions became low. The slope of the locus of points, where the pulsations ceased because of over-richness, indicates that when the mean fuel-spray angle increased, more fuel was caused to pass through the ignition regions. For the same air pattern, it is seen that increasing the total air-fuel ratio or decreasing the mean fuel-spray angle, or both, will cause pulsations to cease because the local air-fuel ratio in the ignition regions becomes too high.

It is noted that for the hollow air pattern, the general trends are the same as for the solid air pattern but the shape of the pulsation region is different. For the lean amplitude transitions, it is believed that the mean fuel-spray angle swings through the ignition regions as the fuel spray is changed sufficiently.

The question might be asked why the shapes of the pulsation regions are different for the solid and hollow air patterns. One possible explanation is that the ignition regions shift somewhat with mixture ratio and air pattern. It seems reasonable that these regions would not have the same location at low air-flow rates at rich amplitude transitions as at high air-flow rates at lean amplitude transitions. One factor involved in such a shift of location of critical region is the variations in air velocity across the air pattern. In the case of the solid air cone, the velocity is highest on the burner axis and decreases with increasing radial distance. Changes in total air-flow rate cause equivalent changes in the air velocities throughout the pattern. The hollow air pattern, on the other hand, has a peak air velocity at some angle with the burner axis. Thus, with increasing radial distances from the axis, the air velocity is first found to increase and then to decrease in magnitude. It is reasonable to expect, therefore, that this complication in velocity profile could result in the more complex lean pulsation limit shown in Fig. 4 for the hollow pattern.

The data as presented in Fig. 4 apply only in a qualitative manner to other burner units. To obtain quantitative data strictly applicable to other units, it would be necessary to study the specific combinations in question.

CONCLUSION

Pulsations present in oil-fired heating units result from acoustical phenomena, even though the energy for driving the pulsations is derived from the combustion process. It is the acoustical system which determines the frequency, and to a large extent, the amplitude of the pulsations. Changes in furnace and burner variables which affect the combustion process also affect the acoustical system. The manner in which the system is affected, however, is not as evident as with the combustion process. It is this unknown effect of furnace and burner variables on the acoustical system which causes the seemingly inconsistent effectiveness of suppression techniques with different heating units. Thus, in this program, it became necessary to explain the mechanism of pulsation in terms of the important furnace and burner variables affecting the acoustical system. This has been accomplished to the extent that the variables important to the generation of pulsations have been delineated; these are the furnace volume, the fuel-spray pattern, the air pattern, and the pattern of the recirculated hot-combustion products. The complex nature of the physical handling of the fuel, air, and combustion products has, however, prevented a full determination of the effect of these variables on the acoustical system.

The detailed mechanism of pulsation has been shown to involve two independent phenomena: an acoustic pressure oscillation and a periodic rate of heat release. The pressure oscillation has been shown to result from the acoustical behavior of the furnace. The periodic heat release is controlled by the periodic ignition of the combustible mixture in the furnace. This periodic ignition appears to depend on the local air-fuel ratio of the combustible mixture in the ignition regions downstream of the blast-tube exit. It is not fully known why these regions have dominance over ignition in any other region within the combustion chamber or how burner configuration affects the location of these regions.

Any suppression technique should affect either the acoustic-pressure oscillation or the periodic rate of heat release. Thus, such techniques as venting[8] the combustion chamber would be expected to affect the pressure oscillation by relieving the acoustic pressure within the furnace. Also, it should be possible to suppress pulsations by affecting the periodic rate of heat release. The problem is, that not enough is known about the location of the ignition regions or precisely what conditions are needed in these regions to prevent pulsations. Thus, it is not now possible to devise definitive techniques involving the fuel-spray pattern, air pattern, or recirculation pattern which will suppress pulsations in all circumstances.

This program has shown that additional information on the interrelationship of the fuel spray, air, and recirculation patterns is required before fully comprehensive pulsation-suppression techniques can be devised. Because of the multiplicity of furnace and burner designs in the industry, the evaluation techniques described should be directed to the specific cases of interest to individual manufacturers.

ACKNOWLEDGMENT

The able assistance of the members of the Pulsation Research Steering Subcommittee of the Technical Advisory Committee on Combustion of precedent ASHAE, in guiding the research and in providing necessary materials, is gratefully acknowledged. Special thanks are due the personnel of the Armstrong Furnace Company who constructed the experimental furnace used in this work.

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Proposed standards

Procedure for announcing proposed Society standards is covered in Section 8.8.24 of the ASHRAE By-laws. At this time **notice is hereby published** that the following standards have been approved by the Standards Committee and review copies are available for comment. Such comments should be submitted to the Technical Secretary not later than January 15.

(1) 22-48R – Methods of Testing for Rating **Water-Cooled Refrigerant Condensers.** This standard includes suggested terms for rating water-cooled refrigerant condensers and establishes test methods for use in obtaining ratings of such equipment.

(2) 40P – Methods of Testing for Rating **Heat-Operated Unitary Air Conditioning Equipment for Cooling.** This standard provides standard test methods for determining cooling capacity of unitary heat-operated air conditioning equipment. These test methods may be used as a basis for rating such equipment. The standard applies to heat-operated equipment which operates non-frosting. It does not include methods of testing the following:

Heat-operated liquid chillers, not part of a unitary air conditioner;

Unitary air conditioners of mechanical compression type;

Heat pumps;

Refrigeration cycles employing Peltier effect;

Combustion engine driven systems.

A. T. BOGGS, III
ASHRAE Technical Secretary

DRAFTING – Section 15, Electrical Diagrams, of the American Drafting Standards Manual is available from ASME, co-sponsor of the standard. This new American Standard carries the ASA designation Y14.15-1960 and was approved by ASA procedure on June 24, 1960. Section 15 contains definitions and general information applicable to most of the commonly-used electrical diagrams. It also includes detailed recommendations on preferred practices for use in the preparation of electrical diagrams. Copies are available at $1.50 each from ASME, 29 West 39th Street, New York 18.

MILK COOLING – A revision to the 3-A Sanitary Standards for Farm Holding and Cooling Tanks became effective September 1, 1960. These sanitary standards concern the material, design, and fabrication of tanks in which bulk milk is cooled and stored on dairy farms. Cooling requirements of such tanks and the performance of refrigeration equipment is included as a part of this standard. The standard was printed in the June 1960 Journal of Milk and Food Technology.

PIPE THREADS—Revised American Standard for Pipe Threads, B2.1-1960, is now available. This American Standard is based on a system of pipe threads known since the 1880's as the Briggs Standard, which in turn incorporated the nominal sizes of pipe (10-in. and under) and the pitches of the thread established even earlier – between 1820 and 1840. In the latest revision of the standard, the dryseal pressure tight joints have been published separately as American Standard B2.2-1960. Published by the American Society of Mechanical Engineers, revision B2.1-1960 is available from ASA or ASME at $3.00 per copy. American Standard B2.2-1960, Dryseal Pipe Threads is available at $3.50 per copy.

REFRIGERANTS – ASHRAE Standard 34 on Designation of Refrigerants was approved September 14, 1960, as an American Standard. The ASA designation number is B79.1-1960 and the title "Number Designation of Refrigerants." Copies will be available for distribution from ASHRAE headquarters or ASA in the near future.

WELDING – Nema has recently announced publication of a revised standard for resistance welding control equipment. The new standard – Resistance Welding Control-IC-2-1960–includes definitions and cycle diagrams for all generally used resistance welding processes. Also listed are minimum standards for such factors as accuracy, time range, size, and capacity, which are widely used in the industry. Copies are available from the National Electrical Manufacturers Association, 155 East 44th Street, New York 17, N. Y., at $1 per copy.

INTERNATIONAL – Increase in world trade since World War II has produced a need for the de-

velopment of international standards for all segments of industry. Such standards are of particular benefit to manufacturers in the export phase of their business. Standards for international use are developed through the procedures established by the International Organization of Standardization commonly known as ISO. Headquarters for ISO are at Geneva, Switzerland, and membership is by country rather than industrial groups. The U. S. is represented in the ISO by ASA. The development of proposed international standards is carried out by technical committees consisting of representatives of interested member countries. Consideration for international standards in any particular field is covered by a specific technical committee.

In 1956 TC 86 on refrigeration was established and the first plenary meeting held in London in 1958. The first meeting of the full technical committee evolved areas of interest in refrigeration for which international standards should be considered. Each of these subjects is handled by a sub-group of the technical committee, as follows:

SC 1 – Safety

SC 2 – Terminology, Definitions and Symbols

SC 3 – Testing of Refrigerating Systems

SC 4 – Testing of Refrigerant Compressors

SC 5 – Construction and Testing of Household Refrigerators

SC 6 – Testing of Factory-assembled Air-Conditioning Units

WG 1 – Designation of Refrigerants

The U. S. is secretariat for SC 6 and WG 1. Meetings of these groups were held in Paris October 17-27 and reports on the results of these meetings will be published in this space in succeeding issues of the JOURNAL.

Nema: Nema standard CN 1-1960 covering **Room Air Conditioners** has been revised to include a cooling load estimate form. This form is suitable for estimating the cooling load for comfort air conditioning installations which do not require specific conditions of inside temperature and humidity. Copies are available from the National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y., at 30c each.

ASHRAE MEMBERSHIP CERTIFICATES


American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
This is to certify that
John R. Sample
is a
Member – Associate Member – Affiliate
and is entitled to all the rights and privileges of such membership.
October 3, 1960
Secretary
President

Although Membership Certificates of precedent ASHAE and ASRE remain valid, those members in all grades, except Students, who wish to do so may obtain new ASHRAE certificates from Headquarters at a cost of $1.25. A sample appears herewith.

Assistant Secretary-Membership ASHRAE
62 Worth Street, New York 13, N. Y.

Please forward an ASHRAE membership certificate. A check for $1.25 is enclosed.

Name to read ....

Membership Grade .... *Month and Year of my Election* ....

NAME ....

ADDRESS ....

Certificates for members of the former societies will be dated February 29, 1959, the date of the merger. Please fill in the coupon and return it to Headquarters.

Amendments to the BY-LAWS

As read to the membership at the Semiannual Meeting in Dallas, February 1-4, and voted upon affirmatively at the 67th Annual Meeting in Vancouver June 13-15. The sections printed herewith supplant those originally provided as of January 29, 1959.

Sec. 4.4 The Board of Directors, for good and sufficient reasons, may waive the dues of any member and the initiation fee of any former member applying for reinstatement who at the time of his resignation was in good standing.

Sec. 5.14 After the close of the fiscal year, the accounts of the Society shall be audited by a certified public accountant approved by the Board of Directors, and the auditor's report shall be presented by the Treasurer at the next Meeting of the Society, and shall be published in the official publication.

Section 8.5 The Chairman and Vice Chairman of each General or Special Committee shall be a Member or Associate Member, except as otherwise provided herein.

Sec. 8.8.1 The Executive Committee shall consist of the President, who shall be its Chairman, the immediate Past President, the 1st Vice President, the 2nd Vice President, and the Treasurer. It shall meet at the call of the President, or upon request of any two (2) members of the committee.

It shall investigate and make reports and recommendations to the Board of Directors regarding matters relating to the Society or any member or members thereof. During intervals between Board of Directors meetings, the Executive Committee shall exercise administrative powers of the Board of Directors. Matters of policy determined by the Executive Committee between meetings of the Board of Directors shall be submitted to the Board of Directors at its next meeting for ratification.

Sec. 8.8.24 The Standards Committee shall have charge of the selection, development, preparation, and submittal to the Board of Directors of all codes and standards in the fields of heating, refrigeration, and air conditioning and ventilating engineering, and all revisions thereof, to be considered for adoption. It shall cooperate with other organizations in the development, preparation, and adoption of codes and standards.

Following approval by the Standards Committee of a code, standard, or a revision thereof, a notice that such is available for comment shall be published in the Society JOURNAL. This notice shall state that preliminary copies will be sent upon request and that comments addressed to the Standards Committee will be received for a period of sixty (60) days following publication of the notice. The Standards Committee, after reviewing such comments, shall make final recommendations to the Board of Directors for adoption of the code, standard, or revision thereof. All written objections which have been overruled by the Standards Committee shall be submitted to the Board of Directors.

Adoption of a code or a standard, or a revision thereof, shall require the approval of the Board of Directors, and the Board of Directors shall assure that proper consideration has been given to it.

Following approval by the Board of Directors, a notice of such approval and availability and effective date of the code, standard, or revision thereof, shall be published in the Society JOURNAL.

The activities of the Committee shall be solely for the development of engineering science, and the Committee shall not engage in influencing enactment of building or other codes, or in propaganda, or other activities designed to influence legislation.

Sec. 8.9 All General Committees and Special Committees, except the Nominating Committee, shall render to the Board of Directors, prior to the Annual and Semiannual Meetings of the Society, reports of their activities and shall submit progress reports at other times on request of the President.

Sec. 8.12 The Board of Directors may by a two-thirds (2/3) vote remove a member of any committee excepting Regions Central Committee, Chapters Regional Committee, and Nominating Committee.

Sec. 9.6 The elected officers of Chapters or Branches shall receive no salary, emolument or compensation for their services as such. Chapters or Branches shall not act for the Society or subject the Society to any financial or other obligation, except such as the Society or the Board of Directors may by resolution specifically assume. Notice to the foregoing effect shall be imprinted on the stationery used by each of the Chapters or Branches. Each Chapter or Branch shall promptly file a copy of its Minutes with the Executive Secretary of the Society and make report to said Secretary of all of its proceedings. Each Chapter and Branch shall file with the Chairman of its respective Chapters Regional Committee its recommendations concerning the policies, procedures and operation of the Society, its Chapters and Branches. No contributions, except dues, and assessments, shall be solicited by Chapters or Branches without the written approval of the Board of Directors. Chapters or Branches shall not issue publications, other than Chapter rosters, or use the Society's name or emblem or Chapter or Branch insignia, without the approval of the Board of Directors. Chapters or Branches shall give no recommendations, endorsements or approvals of any scientific, literary, mechanical or engineering product for the promotion of private interests.

Sec. 11.1 Prerequisites. These By-laws may be amended by a two-thirds (2/3) vote of the Society at an Annual or Semi-Annual Meeting thereof, provided that written notice of the proposed amendment, subscribed by two-thirds (2/3) of the members of the Board of Directors or by fifty (50) members be given at a previous stated or Special Meeting, and that notice thereof as pertinently amended by majority vote at said stated or Special Meeting be also given by the Executive Secretary in the notice of the Annual or Semiannual Meeting.

What ASHRAE Regions and Chapters are doing

First fall meetings of several chapters were highlighted by the presence of James H. Downs, Director of Region V, who spoke on regional and national activities. Heat pumps, dual duct air conditioning, cooling towers and electric heating were among a broad range of topics covered at other technical sessions.

MILAN (ITALY) . . . On August 18th, by official notice from ASHRAE Headquarters, Milan became an overseas branch of the Society. Officers until December 31st are G. F. Bertolini, President; Gaetano du Bot, Secretary; Uberto Stefanutti, Treasurer; and Luciano Jovine and Luigi Mazzini, Board of Governors. President Bertolini was responsible for completion of much of the organization work of the Chapter.

CENTRAL INDIANA . . . James H. Downs, Director of Region V, was present at the first meeting of the 1960-61 season, held on September 14th, and opened the session with an address on benefits resulting from the merger.

Highlighting the meeting was a panel discussion of "Contract Specifications." Speaking were William C. Wright, Director of the Indiana Society of Architects; Frederick B. Morse, Professor of Mechanical Engineering at Purdue University and past-President of the Indiana Society of Professional Engineers; William Martin, representing the Mechanical Contractors Association for the mid-west; and Walter R. Leander, a member of the Trade Relations Committee of the National Warm Air Heating and Air Conditioning Association. Moderating the discussion was William Kercheval, Program Chairman of the Chapter. Main topics were types of specifications, what type produces the highest quality at the lowest cost, how a job should be specified after quality has been decided, practical methods of proposing substitutions, preventing submission of proposals failing to comply with the specifications, determination of compliance with specifications and control and enforcement of prompt payment to subcontractors. Each panelist gave a short talk on specifications as they related to his branch of the profession and then written questions from the audience were answered and discussed.

ROCHESTER . . . On October 5th this Chapter held its first meeting of the 1960-61 season, opening with a discussion on the newly installed refrigeration system for Rochester-Monroe County Civic Center and Memorial Auditorium, presented by Edward F. Nier, Plant Engineer for the project. Arrangements were made to tour the plant.

NEW YORK . . . With increased use of exterior glass in varying amounts, up to and including complete window wall construction, Alfred L. Jaros, Jr., Partner in Jaros, Baum and Bolles and guest speaker at the September 27th meeting, contends that the ratio of unshaded window area to total wall area plays an important role in determination of the type of peripheral air conditioning system best suited from the standpoint of performance and economy.

Preceding the regular technical meeting, a seminar on pumps was conducted, featuring talks by V. J. Cantlupe of Lecourtenay Company, P. F. McDole of Peerless Pump and C. G. Haughton of Worthington Corporation.

TOLEDO . . . Demonstrating the use of small silica discs to convert solar energy directly to electric power, Robert C. Clark of Ohio Bell Telephone Company spoke on "Something New Under the Sun" at the October 3rd meeting.

SOUTHERN CALIFORNIA . . . Presidential Members William R. Harnsworth, Arthur J. Hess and Daniel D. Wile and Fellow Ralph M. Westcott were in attendance at the meeting of September 2nd, at which a certificate of Fellow of the Society was presented to Herbert B. Nottage, Chairman of the Codes and Standards Committee.

Robert Phillips of Carrier Corporation acted as chairman for the evening's technical program, a panel discussion of "Reciprocating, Rotary and Centrifugal Compressors." Applications of each were discussed in turn by Joseph Lutes of Refrigerating Machinery Company, David Nurse of Tennico and Steve Shea of Carrier Corporation. Supplementing discussion of the design and use of the various types of compressors were slides and charts.

Featured speaker at the October 10th meeting was Fred C. Wood, Manager of Air Conditioning

CHAPTER MEETING DATES

	Nov.	Dec.	Jan.
Alamo	—	—	—
Arkansas	22	20	17
Atlanta	14	—	9
Austin	17	3	10
Baltimore	3	1	5
Baton Rouge	16	21	18
Boston	—	—	—
British Columbia	16	9	11
Central Arizona	7	5	9
Central Indiana	8	—	10
Central Michigan	8	13	10
Central New York	9	14	11
Central Oklahoma	14	12	9
Central Pennsylvania	9	14	9
Cincinnati	—	—	—
Cleveland	14	12	9
Columbus	21	19	16
Dallas	21	19	16
Dayton	8	13	10
El Paso	21	19	16
Evansville	1	6	3
Florida West Coast	—	—	—
Fort Worth	—	—	—
Golden Gate	—	—	—
Hampton Roads	8	6	3
Houston	18	23	20
Illinois	14	12	9
Illinois-Iowa	21	—	16
Inland Empire	14	12	9
Iowa	14	12	9
Jacksonville	—	—	—
Johnstown	8	13	10
Kansas City	3	5	3
La Ville de Quebec	8	13	10
Long Island	—	—	—
Louisville	14	10	9
Manitoba	24	—	26
Memphis	21	19	16
Michigan	21	19	—

Sales for York Div, Borg-Warner Corporation, who discussed the practicability and increasing nation-wide acceptance of refrigeration cycle heat pumps for year-round air conditioning of commercial buildings.

He traced the development of the air source heat pump, which is capable of removing heat from even cold winter air, starting with the first large department store system installed at Roanoke, Va., in 1955. Since that time, use of these systems has increased greatly, estimated, by speaker Wood, at totaling more than 10,000 ton of cooling capacity. Major installation cited was the Squaw Valley Winter Olympics facility.

Overall economies of this type of heating and cooling system, both in initial and operating costs, were noted, in particular for the West Coast, where mild climates permit single-stage refrigeration compression equipment in place of the more expensive compound compression required in colder climates where temperatures reach zero and below.

In conclusion, speaker Wood predicted that the air source heat pump will have even broader acceptance as a year-round air conditioning system, using prime energy obtained from either electricity or natural gas and extracting heat from the outdoor air.

CENTRAL PENNSYLVANIA . . . Beginning the 1960-61 season for this chapter was a discussion of the role of the consulting engineer, presented by T. Y. Davis, Middle Atlantic Regional Manager of York Corporation. Illustrating his talk with slides, he reviewed the many facets that must be explored by an engineer in selection of air conditioning for a given building.

HOUSTON . . . Speaker of the evening Charles Dubberly, Manager of the Advanced Engineering Group of General Electric Company, presented a discussion on "A New Concept of Heat Pump Loading and Load Effect" at the September 16th meeting. He enumerated the various electrical, chemical and mechanical loads imposed on heat pump compressors and, with the aid of charts and pictures, defined the areas of load in which these units are expected to operate.

KANSAS CITY . . . Basic principles of dual duct air conditioning and its history over the past fifty years were covered by J. W. Kreuttner, Vice President and Director of Buensod-Stacey, Inc., guest speaker at the September 6th meeting. Discussing advantages, disadvantages and special design considerations, he presented slides illustrating typical and actual installations and comparative cost data. Following his talk was a question and answer period.

At the October 3rd meeting, D. M. Valentine of Surface Combustion Corporation, speaking on "Dehumidification of Air," stated that there are many products that must be manufactured under conditions of low constant humidity and a temperature of approximately 68 F. By use of glycol and lithium bromide as liquid exorbants, moisture in the air can be controlled over a varied range of dry bulb temperature. He also indicated that by such use of liquid exorbants and temperature control, as much as 97% of bacterial and mold growths can be held in check.

DAYTON . . . "Principles of Home Heating with Electric Fuels" were discussed by John W. Norris, President of Lennox Industries, Inc., guest speaker at the first meeting of the 1960-61 season, held September 13th. Attributing present interest in resistance type electric home heating to its promotion by utilities, he reported that the inherently high operating cost of electric heating has been made acceptable by insistance of utilities on tight, well-insulated home construction. Advantages of a central type electric heating system, using forced air, were discussed in comparison with remote type convector and radiant type heaters.

MISSISSIPPI . . . Speaking on cooling towers at the September 26th meeting, Roy Mays of Marley Company pointed out that a tower dissipates all load passed through it and constant blow-down is essential to proper tower operation.

After the program, past-President Forrest North installed new President William Fortner and turned the meeting over to him. President Fortner then introduced new Chapter officers and announced committees.

EVANSVILLE . . . Guest speaker at the September 6th meeting was James H. Downs, Region V Director, who discussed Regional and National matters affecting the Chapter. Explaining channels through which the Society obtains its funds and disbursement of these funds, he spoke on the need for a research laboratory owned and operated by ASHRAE, as opposed to the buying of research time from colleges and universities. A question and answer period followed his address.

(*Continued on page 86*)

	Nov.	Dec.	Jan.
Middle Tennessee	8	13	10
Minnesota	14	—	9
Mississippi	28	23	23
Mobile	28	19	23
Montreal	21	—	16
National Capital	9	14	11
Nebraska	8	13	10
New Mexico	—	—	—
New Orleans	—	—	—
New York	22	27	24
Niagara Frontier	7	19	9
Niagara Peninsula	1	—	3
North Alabama	—	—	—
North Jersey	—	—	—
North Piedmont	—	—	—
Northeastern New York	21	19	16
Northeastern Oklahoma	—	—	—
Northern Alberta	—	—	—
Northern Connecticut	17	14	19
Northern Ohio	—	—	—
Ontario	7	8	2
Oregon	17	15	12
Ottawa Valley	—	—	—
Panama & Canal Zone	—	—	—
Philadelphia	10	8	—
Pittsburgh	21	19	16
Puget Sound	8	13	10
Rhode Island	9	14	11
Richmond	—	—	—
Rochester	2	7	4
Rocky Mountain	—	—	—
Sacramento Valley	—	—	—
St. Louis	21	19	16
San Diego	8	13	10
San Joaquin	—	—	—
Savannah	—	—	—
Shreveport	17	15	19
South Carolina	20	—	16
South Florida	8	13	10
South Piedmont	—	—	—
Southern Alberta	15	20	17
Southern California	14	12	10
Southern Connecticut	10	—	12
Toledo	7	5	9
Tucson	8	6	3
Utah	—	—	—
West Texas	25	—	27
Western Massachusetts	17	—	19
Western Michigan	14	12	9
Wichita	21	19	16
Wisconsin	21	—	16

Meetings ahead

November 14-16—National Warm Air Heating and Air Conditioning Association, 47th Annual Meeting, Cleveland, Ohio.

November 14-18—National Ice Association, Annual Convention, Washing, D. C.

November 15-17 — Building Research Institute, Fall Conferences, Washington, D. C.

November 17 — National Electrical Manufacturers Association, Annual Meeting, New York, N. Y.

November 18-22 — Air Conditioning and Refrigeration Institute, Annual Meeting, Hollywood Beach, Fla.

November 20-23 — Refrigeration and Air Conditioning Contractors Association, Annual Meeting, Miami, Fla.

November 27-December 2—American Society of Mechanical Engineers, Annual Meeting, New York, N. Y.

November 28-December 2—24th National Exposition of Power and Mechanical Engineering, New York, N. Y.

December 1-2 — National Association of Practical Refrigerating Engineers, Annual Meeting, St. Louis, Mo.

December 12-15—Industrial Building Exposition and Conference, New York, N. Y.

January 23-24 — Industrial Heating Equipment Association, Dearborn, Mich.

February 10-11—Air Conditioning and Refrigeration Wholesalers, Annual Convention, Chicago, Ill.

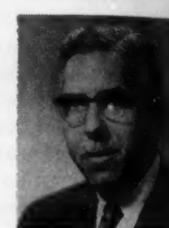
February 13-16 — American Society of Heating, Refrigerating and Air Conditioning Engineers, Semiannual Meeting, Chicago, Ill.

February 13-16 — 15th International Heating and Air-Conditioning Exposition, Chicago, Ill.

March 5-8 — National Association of Frozen Food Packers, Annual Convention and Exposition, Dallas, Texas.

People

Daniel D. Wile, immediate past-President of ASHRAE, has been appointed Executive Vice President of Recold Corporation, but continues as Vice President in Charge of Engineering. A graduate of the University of Kentucky College of Engineering, he was elected to membership in the former ASRE in 1934 and in the former ASHAE in 1944. Active in work of ASRE, he has served on the Committees on Rating and Testing Air Conditioners (Chairman, 1946), Standards (Vice Chairman, 1948), Awards (1949), General Technical (Vice Chairman, 1950-51; Chairman, 1952), Research (1951), Technical Coordinating (member, 1954; Vice Chairman, 1955-57), Program (Chairman, 1954), and Membership Relations (Chairman, 1957-58). Mr. Wile has also served the Society as a member of Council from 1952-58; as Treasurer, 1956-57; 2nd Vice President, 1957-58; and 1st Vice President, 1958-59. He was 2nd Vice President of ASHRAE and Chairman of Regions Central Committee from January to June 1959, 1st Vice President from July to December 1959 and President from January to June 1960. His frequent contributions to refrigeration and air conditioning literature cover a wide range of subjects, including evaporation design, 1931; expansion valve capacity measurement, 1935; refrigerant controls (International Congress of Refrigeration), 1936; test apparatus for room thermostats, 1936; calorimeter for small compressors, 1939; psychrometry in the frost zone, 1944; psychrometric chart (co-author), 1946; air flow measurement, 1947; evaporative condenser performance, 1950; performance of air conditioning coils, 1953; carcass coolers, brine spray or dry coil, 1956; and purging industrial systems, 1959. His work on the ASRE Data Book includes chapters in the basic volume on psychrometry and evaporative condensers. Mr. Wile's experience in the industry is marked by developments for which he holds many patent awards. He is a recipient of the ASRE Best Sections Paper Award and twice received the ASRE Wolverine Award for outstanding contributions to refrigerating engineering. He was Vice Chairman of the Detroit Section of ASRE in 1937 and Chairman of the Los Angeles Section in 1956.



James A. McIlrath, formerly Vice President of United States Cold Storage Corporation, is now President of Dry Storage Corporation in Chicago.

T. J. Ammel, Sales Manager, O.E.M. Products, for York Div of Borg-Warner Corporation for the last two years, has been given the additional responsibility of handling Mobile Products. A past-Chairman of the Detroit Section of the former ASRE and Chairman of the General Technical Committee in 1957-58, he has also served as Region VII Director. Active in the Air Conditioning and Refrigeration Institute, he was Chairman of the Small Compressor Sections in 1956-57 and is currently Chairman of the subsection covering hermetic compressors up to ten hp.

A. G. Dixon, Executive Vice President of Modine Manufacturing Company, succeeds to the presidency of that organization. A member of the Board of Directors, he has been associated with the company since 1926, when he was employed as an engineer. In 1931 he was appointed Sales Manager for the Heating Div, continuing in this position until 1943, when he was named Secretary. He became Vice President and Secretary in 1948, a director in 1953 and Vice President of Engineering in 1954. In 1957 he was advanced to Executive Vice President. An alumnus of the University of Illinois, with a B.S. in engineering, he has been a member of ASHRAE since 1928.

Lawrence E. Jennings, Jr., is now Product Manager, Commercial Dept, Danville Div, Bohn Aluminum & Brass Corporation. A graduate of Trinity College, his first position was as a sales engineer for Sturtevant Div, Westinghouse Electric Corporation. Directly prior to joining Bohn, he was Chief Engineer for a Michigan City, Ind., manufacturer.

H. L. Ross is now Manager of Engineering of Allis-Chalmers Manufacturing Company's newly consolidated Pump and Compressor Dept. With the company since receiving his mechanical engineering degree from Yale University in 1928, he became Manager of the Centrifugal Pump Dept in 1959. Prior to that, he had been Assistant Manager and Chief Engineer.

James A. Wheeler is now Product Manager, Air Conditioning Dept, air side, for the Industrial Div of American Radiator & Standard Sanitary Corporation. A mechanical engineering graduate of the University of Florida, he brings to his new position a background of 26 years in the air conditioning field. Starting with an American Blower Div agent in 1934, he joined the Div in 1937 as a sales engineer. Prior to accepting his new assignment, he had been Manager of the Industrial Div's Houston office since 1946.

Douglas Longman, previously with Sirocco, has joined the staff of Trane Company of Canada. Among other Montreal Chapter members assuming new positions are: **Alan W. Oakes,** who has left Canadian Ice Machine Company to join Trane Company of Canada; **Wes Muir,** now associated with **John Holden,** Consulting Engineer, to form the partnership of Holden & Muir; **John Haskeny,** forming the firm of John Haskeny & Associates, Consulting Engineers; **Alec Moore,** who has formed a consulting engineering association, Moore, Cowan & Associates; and **David E. Harvey,** now Sales Manager of Dunham-Bush.

William C. McMichael has been appointed Director of Sales of CRS Industries, Inc., an organization specializing in research and sale of products and systems for control of air cleanliness and odors. With a background of 16 years in sales consultation and management in the field of air conditioning, he has served with Air Conditioning Associates, Inc., and was Manager of the Cooling Div of Bryant Air Conditioning Corporation.

Armand Cowan is the new General Manager of Imec of Florida, Inc., which was formerly Mechanical Installations, Inc. Prior to this appointment, he was with McDonald Air Conditioning, Inc.

Glen D. Winans, General Superintendent of Detroit Edison Company's Central Heating Dept, retired October 1st after 38 years of service with the company. A graduate of Ohio Northern University, where he earned his mechanical engineering degree in 1921, he joined Edison in that same year as an inspector in the Central Heating Dept, where he has served in several supervisory positions, including Steam Distribution Engineer, Assistant Superintendent and Assistant General Superintendent. He was promoted to General Superintendent of Central Heating in 1957. A Charter Member of the Engineering Society of Detroit and a former Chairman of the Society's Civic Affairs Committee, he is past-President of the National District Heating Association and a memmer and past-President of the Michigan Chapter of ASHRAE. Succeeding him is **Leo F. Collins,** an alumnus of the University of Dayton College of Engineering and holder of an M.S. conferred by the University of Detroit. With the company since 1925, he is a past-President of the National District Heating Association and Chairman of the ASHRAE Technical Committee on Corrosion.

WINANS

COLLINS

Thomas A. Marshall, Jr., has been elected Executive Secretary of the American Society for Testing Materials by its Board of Directors, effective October 15, 1960. He is currently Senior Assistant Secretary of the American Society of Mechanical Engineers. Graduated from Georgia Institute of Technology in 1932 with a B.S. degree in aeronautical engineering, he joined Metropolitan Life Insurance Company, serving in various capacities. In 1951, he became Executive Secretary of the Engineering Manpower Commission, which had just been formed by Engineers' Joint Council. A year later he became Secre-

Others are saying—

noise problems . . . . which confront the ventilating engineer can be divided into three basic parts: first, it is necessary to obtain the noise characteristics of the system, that is, the sound which would be heard by occupants if no acoustical treatment were applied; noise levels which would be acceptable within the occupied zones must then be decided; and, finally, the difference between the noise of the untreated ventilating system and permissible noise in the building indicates the degree of noise attentuation required for satisfactorily quiet operation of the system. In this article, a survey of existing information on the subject has been made and suggestions are put forward for making an assessment. *Journal of the Institute of Heating and Ventilating Engineers, September 1960, p 197.*

salt-to-fresh water . . . . conversion by freezing, thermodynamically and from a scale and corrosion viewpoint, has potential for a variety of applications. There are at present two leading methods of producing sea water ice: freeze evaporation and direct cooling. In the former, sea water is introduced into a high vacuum chamber and flash cooled to a temperature low enough to produce ice crystals. In the second process, a refrigerant such as isobutane is introduced directly into the brine, thus freezing some of the solution into ice crystals. *Mechanical Engineering, October 1960, p 57.*

heat pumps . . . . as used in multistory office buildings have considerable potential. Comprising the heat pump reclaim cycle are a centrifugal refrigeration machine and standard equipment normally used in multistory applications. A cited installation is in a building which sustains itself on the heat inherent within a compact office building, without necessity for an outside source of heat to load the refrigeration machine artificially. *Heating, Piping & Air Conditioning, September 1960, p 93.*

BULLETINS

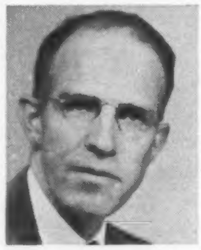
Electric Heaters. Subject of a four-page bulletin is an extensive line of electric baseboard and floor insert heaters. Baseboard units are available in 500 to 2000-watt capacities and widths from 2 ft 1½ in. to 8 ft 1½ in. Floor insert models are offered in 350 and 750-watt capacities and 14 and 30-in. widths. Cabinet convector types are also available, in 1000 and 2000-watt capacities and 24½, 36½ and 48½-in. widths. Element is hermetically sealed. Steel fins are bonded to steel core for max heat transfer.
Rittling Corporation, Buffalo 5, N. Y.

1960 Estimating Catalog. Illustrative of most of the air conditioning, ventilating, refrigerating and heating products manufactured by this company, this 40-page pricing guide provides quick selection of blower units, fans, coils, cooling towers, evaporative condensers, valves, fittings and other equipment. Introduced for the first time is a line of self-contained packaged roof air conditioning units in sizes from three to thirty ton, complete with air cooled condensers and gas heaters.
Blazer Corporation, 173 Market St., Passaic, N. J.

Strainers, Traps. Flyer 978S-60 provides information on a new line of strainers for steam, water and gas service, with a choice of basket perforations, for pressures to 150 psi. Tables present data on dimensions of both screwed and flanged body types and on ratio of free area of strainers and free area of pipe. Included in a series of five bulletins is information on various types of traps: thermostatic traps for low-pressure vapor and vacuum steam heating service, available with diaphragm or bellows type elements (Flyer 970-60); Sylphon thermostatic traps (Flyer 950-60); Series M27 drip traps, available with or without thermostatic air by-pass (Flyer 927-60); drip traps for process steam, Series M80 (Flyer 980-60); and Series M78 process steam traps (four-page Bulletin 978T-60).
Modine Manufacturing Company, 1500 DeKoven Ave., Racine, Wisc.

Acoustic Terminal Control Units. Detailed descriptions of this line of units for all-air high-velocity systems are contained in 36-page Catalog 1060. Provided are extensive information and specifications on three ceiling models and two window perimeter

tary of EJC as well. He joined the staff of ASME in 1954, to manage the Society's 75th Anniversary Celebration and its public relations activities. In 1956 he was named Head of Technological Service, leading to his appointment as Assistant Secretary and, later, Senior Assistant Secretary.



SIGNOR

DULL

William M. Dull has been appointed Assistant General Superintendent of the Central Heating Dept of Detroit Edison Company. Educated at the University of Michigan College of Engineering, he is a member of numerous local and national engineering societies. ASHRAE activities include membership on the Board of Governors, Program Committee and Student Chapter Committee of Michigan Chapter. **Carl W. Signor** is now Supervisor of Technical Staff for the same department at Detroit Edison. Also a graduate of the University of Michigan, he is a committee member of Michigan Chapter, ASHRAE, and a member of the Technical Committee. An article by him, "What We Learned About Water Hammer," appeared in the April 1960 issue of the JOURNAL.

D. A. Forberg, Vice President of Air Comfort Corporation since 1952, has been elected President. **J. J. Smerz** has been named Executive Vice President and will be in charge of sales.

Earl R. Miller has been named Wichita representative for General Blower Company Div, Ilg Electric Ventilating Company. He has been associated with D. M. Allen Company since 1955 and has had several years field experience.

K. M. Newcum, formerly with Remco, Inc., is now Sales Manager of Halstead Industrial Products, Inc. He is presently Chairman of the ASHRAE Membership Development Committee and was Chairman of the ASRE Membership Committee and a member of the ASRE Membership Relations Committee.

I. S. Dunn, previously service supervisor for Westinghouse Electric Corporation in the Louisiana, Mississippi and Alabama areas for several years, has been appointed Staff Service Engineer in the Product Service Dept at the company's Staunton, Va., plant.

Russell S. Townsend, in his new capacity as Chief Engineer for the Michigan City, Ind., plant of Dunham-Bush, Inc., will head all engineering activities for air conditioning, heating and refrigeration products there. A graduate of Purdue University, he was associated previously with Crosley, Avco Manufacturing Corporation, Admiral Corporation and Servel, Inc., in engineering positions.

Gordon Morrow is a principal in Brownlee-Morrow Engineering Company, appointed to represent McQuay, Inc., in the Birmingham, Ala., area. Graduated from the University of Alabama in 1949, he was a sales engineer with Air Engineers prior to formation of his own company.

C. Kelsey Sanders, a manufacturers' representative in the Miami area for more than ten years, has been named by Recold Corporation to represent their air conditioning line. In addition to ASHRAE, he is a member of the Florida Engineering Society.

E. M. Mittendorff has resigned from the University of Virginia to accept an appointment with the International Cooperation Administration as Deputy Industry officer for Iran, with headquarters in Tehran.

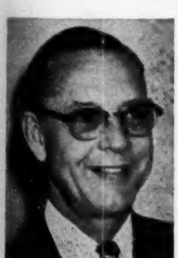
Edward E. Harwood becomes Sales Manager, Original Equipment Manufacturer Div, White-Rodgers Company. Most recently Manager of the Cleveland Region, he has had 23 years of association with most of the larger controls users in the country.

H. L. Stevens, President of Stevens, Inc., since 1937, died recently at the age of 62. Well known as a leader in the field of aviation, he was responsible for bringing airline service to Hutchinson, Kansas, where he has lived for most of his life. In 1958, the airfield at Hutchinson Municipal Airport was named "Hap Stevens Field" in recognition of his work. A graduate of the University of Kansas School of Architecture and Engineering, he was chairman or a member of numerous committees and organizations in the fields of plumbing, air conditioning, engineering and architecture. He served on the Hoover subcommittee "Elimination of Waste Series," authored many technical papers for trade journals and was founder and editor of the journal "Bending Spring." He designed the Stevens Sensible Cooler and Air Conditioner, now manufactured by the company of which he was President. Among the associations and technical committees of which he was a member are ASHRAE, National Association of Plumbing Contractors, U. S. Public Health Service Technical Committee on Plumbing Standards, American Society of Sanitary Engineering and Standards Council of the American Standards Association.

Maurice H. Hofmeister, associated with heating and air conditioning in the Chicago area for the thirteen years following his graduation from Northwestern University in 1947, is now Sales Representative for Warren Webster & Company. He rose through Bell & Gossett Company from heating engineer to General Manager, Air Conditioning Div, before leaving to form Hofmeister Company earlier this year.

Henri Soumerai has been appointed Director of Research and Development for air conditioning, refrigeration, heating and heat transfer products manufactured by Dunham-Bush, Inc. Formerly associated with the Air Conditioning and Refrigeration Div of Worthington Corporation in this country and with Therma A. G. in Switzerland, he is well known for his work in compressor development and heat transfer. A graduate of Swiss Federal Institute of Technology in Zurich, he has been active in the work of technical societies in the United States, is the author of numerous technical papers and wrote the ASRE Data Book chapter on Compression Refrigeration.

R. A. Frey is President of Frey Equipment Company, Dayton, Ohio, recently appointed air conditioning and ventilating representative for McQuay, Inc. The company has been assigned the entire Dayton area.



Ralph M. Westcott, former President of Consulting Engineers Council and Consulting Engineer with Holladay and Westcott, was presented with the Consulting Engineers Association of Washington "Engineer of the Year" award. A member of the former ASRE since 1943, he was a member of Council from 1946 to 1957 and served on several committees prior to the formation of ASHRAE.

Robert H. Stevenson, in his new capacity as Export Manager for Taco Heaters, Inc., will be responsible for the sale of Taco products to Europe, Canada and other areas outside the continental United States. With the company since 1956 as a member of both the Product Development and Marketing Depts, he was Supervisor of Marketing Administration and Controls prior to his latest appointment.

Gerald B. Schroeder, Application Engineer at Lennox Industries' Columbus, Ohio, headquarters, will be technical chief of Lennox Heating Company, Ltd., a newly announced subsidiary which will commence operations in England in the near future.

Ernest F. Siegel, formerly Chief Mechanical-Electrical Engineer and associate with Green Associates, Inc., has announced the opening of his office in Baltimore, Md., for the practice of consulting engineering.

models. Also contained are engineering data on system noise and tables of static pressure losses and regains.
Carnes Corporation, Verona, Wisc.

Range Hoods, Ventilating Fans. Five models of range hoods are described in the first seven pages of 16-page Catalog 268-L, ceiling and wall-type ventilating fans in the rest of the booklet. Each model is illustrated and discussed in detail, including features, extensive specifications, dimensions, installation and ordering information. Last page in the catalog presents a line of accessory items such as roof ventilators, back-draft dampers, switches, shutters, roof jacks and outside wall caps.
Leigh Building Products Div, Air Control Products, Inc., Coopersville, Mich.

Slime Control. Discussing how judicious use of chlorine and supplemental use of other biocides can extend cooling tower life is a new water conditioning data sheet, "Slime Control with Chlorine and Non-Oxidizing Biocides."
Betz Laboratories, Inc., Gillingham & Worth Sts., Philadelphia 24, Pa.

Gauges, Thermometers and Controls. Pressure gauges described in six-page Bulletin 3020 are the bourdon-tube type, covering a wide variety of industrial applications. Photographs illustrate each of the ten types covered, with information on dimensions, accuracies, construction features and suggested uses given in the text. Included under temperature measurement are dial, glass tube, panel type and multi-angle thermometers. Different models are shown and text covers information on construction, dimensions, ranges and typical applications. Control instruments discussed include indicating controllers, valve positioner and pilot options, recorders, chemical attachments and accessories.
United States Gauge Div, American Machine and Metals, Inc., Sellersville, Penna.

Valves, Lift Fittings. Subjects of a series of flyers are spring-packed radiator supply valves, Series M10 (Flyer 910-60); Series M600S Sylphon bellows packless valves (Flyer 960-60); double service valves (Flyer 917-60); and lift fittings for vacuum systems (Flyer 924-60). Provided in the bulletins are product illustrations, dimensions, descriptions and technical data.
Modine Manufacturing Company, 1500 DeKoven Ave., Racine, Wisc.

Candidates for ASHRAE Membership

Following is a list of 131 candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility in the acceptance of these candidates for membership by advising the Executive Secretary on or before November 30, 1960 of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted by the Board of Directors.

Note: * Advancement † Reinstatement

REGION I

Connecticut

HILLERY, H. R., Pres., The H. R. Hillery Co., Groton.

LORIOT, F. X. JR., Sales Engr., Conn. Valley Refrigeration Inc., East Hartford.

Massachusetts

FINNEY, H. W.,* Sales Engr., Barber-Colman Co., Westwood.

LEVENBACK, GEORGE,* Sales Mgr., Simard, Inc., Lynn.

New Jersey

CZEINER, F. J., Appl. Engr., Worthington Corp., East Orange.

KOUTSAFTES, EFSTRATIOS, Appl. Engrg. Aide, Worthington Corp., East Orange.

LIEBERMAN, LESTER,* Pres., Atmos Engrg. Inc., Newark.

New York

ACITO, T. E., Engr., Voorhees Walker Smith Smith & Haines, New York.

CANDAN, SALIH, Sr. Mech. Engr., Uhl, Hall & Rich, Niagara Falls.

CARMICHAEL, R. W., Dist. Repr., Warren Webster Co., Albany.

DERRICO, J. A., Sales Engr., Johnson Service Co., Albany.

FEINER, R. J., Htg. Vtg. A-C Designer, Slocum & Fuller, New York.

FISCHER, H. C.,† Vice-Pres., Thermo-Craft Corp., New York.

GREGORY, G. L., Appl. Engr., Carrier Corp., Syracuse.

GREWER, P. D., Mgr. Com. & Ind. Div., Better Heating-Cooling Council, New York.

HARBER, M. A.,* Assoc., Raymond J. Rice, Engr., New York.

HUGHES, W. J., Sales Engr., Therma-fluid Dynamics Inc., Long Island City.

LEAK, J. M., Sales Repr., Vibration Mountings, Inc., Corona.

MCGUIRE, E. B., Htg. Vtg. A-C Designer, Slocum & Fuller, New York.

MURRAY, F. E., Service Mgr., R. J. Murray Co., Inc., Schenectady.

SOLOMON, I. M.,* Pres., S & S Air Conditioning Corp., Hicksville.

TIKTIN, GIDEON, Designer, Slocum & Fuller, New York.

WILLIAMS, H. S.,* Proj. Engr., Dayton T. Brown, Inc., Copiague.

WOODLEY, C. R., Engr., Letourneau-Westinghouse, Tarrytown.

Rhode Island

SILVERMAN, MELVIN, Sales & Appl. Engr., Providence Sheet Metal Co., Providence.

REGION II

Canada

APOUCHTINE, DIMITRI, Tech. Salesman, Control Equipment Co. Ltd., Montreal, Quebec.

BERGERON, J. B., Engr., R. Carmichael, Montreal, Quebec.

CARMICHAEL, RAY, Owner, R. Carmichael, Montreal, Quebec.

GAUDETTE, PAUL, Repr., American-Standard (Canada) Ltd., Montreal, Quebec.

KASRIEL, ALADAR,* Tech. Mgr., Refrigeration Enterprises Ltd., Montreal, Quebec.

LANGER, ERNEST,* Field Engr., J. & E. Hall (Canada), Ltd., Montreal, Quebec.

MURRAY, D. P., Appl. & Sales Engr., American Air Filter (Canada), Ltd., Montreal, Quebec.

NEILL, B. C., Engr., Morrison Air Conditioning, Ltd., Montreal, Quebec.

SPRINGER, J. C.,* Pres., York Equipment Ltd., Verdun, Quebec.

REGION III

Delaware

TABOR, J. E., Sr. Section Leader, E. I. du Pont de Nemours & Co., Newark.

District of Columbia

AREY, H. R.,† Pres., Stern & Arey, Washington.

MARTIN, M. R.,† Asst. Engr., Air-Conditioning & Refrigeration Inst., Washington.

Maryland

CUDDEBACK, C. N., Appl. Engr., York Corp., Baltimore.

Pennsylvania

BETTENCOURT, D. C.,* Engr. in Training, Frick Co., Waynesboro.

METZ, G. A., Mech. Engr., Sylvania Electric Products Inc., Williamsport.

Virginia

DAVEY, R. P.,* Sr. Field Engr., Powers Regulator Co., Arlington.

REGION IV

Florida

OSSI, F. T., Engr., Estimator, Cleveland Consolidated, Jacksonville.

REGION V

Indiana

LERZAK, J. J.,* Mech. Engr., Walter Scholer & Assoc., Lafayette.

PETERS, H. P., Prod. Engr., Whirlpool Corp., Evansville.

Kentucky

BROWN, W. K., JR.,* Instr. of Mech. Engr., University of Kentucky, Lexington.

North Carolina

ANDREWS, J. V., JR., Pres. J. V. Andrews Co., Charlotte.

Ohio

DAVIS, N. E., Dvlpt. Engr., Chrysler Airtemp, Dayton.

GRAINGER, G. W., JR., Mfrs Agt., Toledo.

SHUMAN, S. A.,* Pres., Julian Speer Co., Columbus.

SOLEM, G. G., Sales Engr., Johnson Service Co., Dayton.

REGION VI

Illinois

BANCHAK, J. C., Jr. Engr., Vern E. Alden Co., Chicago.

BRADY, R. T., Proj. Engr., Vapor Heating Corp., Chicago.

FANELLA, R. J., Supvsr. of Mech. Tests, Vapor Heating Corp., Niles.

MOSHER, L. J., JR., Tech. Engr., Vapor Heating Corp., Chicago.

SLEEPER, T. E., SR., Pres., Mechanical Insulation Co. Inc., Kewanee.

Iowa

MCKINLEY, C. J., JR., Sales Engr., The Powers Regulator Co., Des Moines.

Michigan

GOGOLA, M. L., A-C. Repr., Michigan Consolidated Gas Co., Detroit.

JESSUP, R. J., Appl. Engr., American-Standard, Ind. Div., Dearborn.

Wisconsin

JOHN, J. S., Sales Engr., Johnson Service Co., Milwaukee.
MOOSEBRUGGER, W. J., Engr., Vilter Mfg. Co., Milwaukee.

REGION VII

Alabama

JACKSON, D. M., Com. Sales Repr., Alabama Power Co., Birmingham.
KEYSER, J. T., JR., Com. Sales Engr., Alabama Power Co., Birmingham.
PARKER, J. W.,* Engr., Southeastern Electric Co. Inc., Andalusia.
WATTS, E. R., JR., Partner, Watts Engineering Sales, Birmingham.

Kentucky

BRUCE, J. R.,† Br. Mgr., The Power Regulator Co., Louisville.

Missouri

ANDGREGG, F. O., Pres., Service Heating Co., Kansas City.
ATKINS, D. G., Sales Engr., Carrier Corp., Kansas City.
BIRZER, RICHARD, Research Engr., Refrigeration, The Vendo Co., Kansas City.
CALVERT, D. R., Sales Engr., Armstrong Cork Co., Kansas City.
GAINES, GENE,† Pres., Midwest Services, Inc., Joplin.
HOUGHTON, C. H., Repr., Manufacturers' Sales Co., Kansas City.
LANHAM, R. H., Repr., Doll Heating & Cooling Co., Kirkwood.
LORD, J. W., Sales Engr., C. L. McMichael Co., Kansas City.
PATTERSON, R. W., Owner, American Engineering Co., Kansas City.
SMITH, W. E., Partner, Ambrose & Smith, Kansas City.

REGION VIII

Louisiana

ANTICI, E. M., A-C. Engr., Arkansas-Louisiana Gas Co., Shreveport.

Oklahoma

ARCHER, D. J., Pres., Archer-Hinman Supply Co., Tulsa.
LUFF, G. S., Mech. Engr., Coston-Frankfurt-Short, Oklahoma City.
MITCHELL, I. J., Estimator, Salesman, Southern Sheet Metal Works, Tulsa.

Texas

GRAF, C. H., Repr., M. L. Rendleman Co., Houston.
STINNETT, T. M., Small Tonnage A-C. Repr., Houston Natural Gas Corp., Houston.
WORTMANN, H. W.,* Supervisory Gen. Engr., Office of Center Engineer, Fort Bliss.

REGION IX

Colorado

ROSE, D. L., Estimator, McCombs Supply Co., Denver.

Kansas

FARRIS, R. W., Dist. Mgr., White-Rodgers Co., Wichita.
WARE, E. E., Test. Lab. Tech., Coleman Co., Inc., Wichita.

Nebraska

THOMPSON, J. M.,* Chief Mech. Engr., Nance Engineering Inc., Omaha.

New Mexico

HUFF, G. R., Mech. Engr., New Mexico State University, University Park.
WILLIAMS, R. F., Mech. Plan Checker, City of Albuquerque, Albuquerque.

Utah

BUCLEY, J. D., Owner-Mgr., Jack D. Buckley Mech. Cont'r, Provo.
DELIUS, HELMUTH, Sales Engr., The Trane Co., Salt Lake City.
MCCAFFREE, D. G., Sales Engr., The Trane Co., Salt Lake City.
PATTON, L. D., Mgr. Hgt. Sales, Heating & Plumbing Supply Inc., Provo.

REGION X

Arizona

DIMOND, J. R.,† Mech. Engr., Motorola Inc., Phoenix.
THOMSON, Q. R., Assoc. Professor, University of Arizona, Tucson.

British Columbia

SUME, R. R., Design Mech. Engr., Crowther MacKay & Assocs. Ltd., Vancouver.

California

ANDREWS, P. M., Sales Engr., American-Standard, Ind. Div., Los Angeles.
ASKEW, S. E.,† Sales Engr., Thermal Products, Inc., Los Angeles.
CORNELL, C. M., Mech. & Elec. Engr., Chester D. Walz & Assocs., San Diego.
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ASHRAE'S consolidated

Guide and Data Book

will appear in 1961

1961 will be an historic milestone in the 65 years of publishing by ASHRAE and its predecessor societies. For the first time, two of the top technical manuals in the fields of Heating, Refrigeration, Air-Conditioning and Ventilation will appear under one cover.

The Heating, Ventilating and Air-Conditioning GUIDE, published since 1922, and the Air-Conditioning and Refrigerating DATA BOOK, which made its first appearance in 1932, will be presented by the Society next year as the GUIDE AND DATA BOOK.

During their 38 and 28 years of existence, respectively, the GUIDE and the DATA BOOK have had their trials and tribulations, have been praised and criticized, and, because of their sheer weight and bulkiness have often been a trial for book-toting engineering students. But from their first printings, they have rated the stamp of ultimate "authority." Written by experts, both books have been prized as year-'round references by engineers, architects, contractors, government officials and students. Distributed to the membership as part of their dues, these books have also been bought by non-member engineers, by industrial firms and by technical schools and colleges for use as text books. Testimonials have been legion:

From a research engineer – "For decades THE GUIDE has told our product story authoritatively. Nothing could take its place."

From a consulting engineer – "THE GUIDE has been practically a 'bible' for us since it was first published. It is the best reference work for Heating, Ventilation and Air-Conditioning that I know and it is in constant use by the engineers in our office."

From a college president – "By far the best reference book in its field – for engineers, architects and users of equipment." (GUIDE)

From a professor of Mechanical Engineering – "In spite of the size, bulk, weight, and cost, I have specified that the GUIDE will be used in next semester's classes."

From an operating engineer – "I received my copy of the 'Refrigerating DATA BOOK and I must say that I am highly pleased with it. It is the best book I ever came across covering the subject of refrigeration. I may also say that you may use my name as a very highly satisfied owner of the DATA BOOK."

From an air-conditioning company – "We want to take the opportunity to compliment you on the completeness of this book. It is a splendid piece of work–the only one we know of that has such a world of information. We have repeated our order and our New York office can also make use of some of these books." (DATA BOOK)

From a practical man – "Haven't found one page that was not worth the price of the volume." (DATA BOOK)

From a consulting engineer – "I cannot forbear writing to congratulate you and the various authors on this exceedingly valuable and interesting and helpful edition." (DATA BOOK)

Necessity for authoritative engineering books – The transition of the GUIDE and the DATA BOOK into the unified 1961 publication parallels the history of ASHRAE. The present Society, which was incorporated in 1959, emerged from the realization of strong-minded, professional engineers that there was a real need for societies which would probe, develop and promote the arts and sciences of Heating, Refrigeration, Air-Conditioning, Ventilating and allied fields. The decision to publish was also made to answer a real need . . . to provide engineers in specific fields with authoritative sources of information.

THE GUIDE

Early in 1894, five men met for luncheon in a New York restaurant to discuss the possibility of forming a society of heating and ventilating engineers. The first meeting of this American Society of Heating and Ventilating Engineers was held in January of 1895. There were 75 charter members.

The growth of this society was steady until 1914, at which time there were 500 members. Following World War I, the membership increased at a greater rate and, by 1930, there were about 2,200 members. In 1917, one of the committees of ASHVE was the Research Bureau Committee, which was studying ways and means to start a research laboratory. The research committee was divided into three sections, one of which was known as the Publications Committee.

This Committee suggested that an engineering handbook be compiled to cover heating, ventilating and air-conditioning. The various sections of the book were to be written by qualified authorities who were also members of the Society. There were two fundamental reasons which influenced ASHVE in deciding to publish an engineering manual: 1, no published authority of this type was then available and 2, any money raised from publishing such a book would be used for the Society's fledgling research laboratory.

The first GUIDE was published in 1922. From its conception, the purpose of the GUIDE was quite clear, as exemplified by the statement of Professor Perry West, one of the founders and chairman of the first GUIDE Publication Committee: "No pains will be spared in making this the last word among publications of this kind; by keeping it confined to this one particular line, it is felt that it can be made to show a great improvement over anything of a similar nature yet produced."

During its years of publication by ASHVE, which in December of 1954 was reincorporated as the American Society of Heating and Air-Conditioning Engineers, Inc. (ASHAE), the GUIDE enjoyed such a growing prestige that in 1960, advertisements could, with confidence, refer to it as "Today's Giant in the Field!" The progress of the heating and ventilating industries since 1922 is recorded in the GUIDE.

The 38th edition (1960) contained 57 chapters, covering 792 pages devoted to authoritative tech-

nical material, plus indices and several hundred pages of advertising. The technical chapters included such sections as Fundamentals; Environment, Comfort and Physiological Principles; Heating and Cooling Loads; Room Heating and Cooling Methods and Equipment; Air Systems and Equipment; Steam and Water Systems and Equipment; Heat Generating Methods and Equipment; Refrigeration, Spray Apparatus, and Sorbents; Controls, Instruments, and Motors; Specific Applications; Industrial Systems; and General. The Catalog Data Section, which contained the advertising, listed products of 299 manufacturers of heating, ventilating, cooling and air-conditioning equipment for use in various types of installations.

The printing order for the 1960 GUIDE was 30,000 copies. Of this quantity, 17,500 were distributed to Society members. Several more thousand were ordered immediately by non-members and relatively few are still available.

THE DATA BOOK

Ten years following the founding of ASHVE, a group quite as dedicated met, also in New York, to consider the formation of an organization to promote the study and development of the science of refrigeration and its practical applications. They selected a committee to draft a constitution and By-laws, which were officially adopted on December 5, 1904. This date marks the formal birth of the American Society of Refrigerating Engineers (ASRE).

Significantly, the raison d'etre of ASRE, as stated by President John E. Starr in 1905, closely paralleled that of ASHVE: "We have undertaken the responsibility of speaking with authority, of finding the truth and proclaiming it, and a critical world will hold us to our task or pass us by as unworthy."

In the beginning, ASRE members concerned themselves principally with the design, manufacture, installation, and use of large industrial refrigerating machinery. This Society was in existence 20 years before emphasis was switched to small equipment and the eventual production of small package units on large scale for broad distribution.

As early as 1924, ASRE published a series of loose-leaf circulars containing related engineering data. The first one was "Heat Transmission of Insulating Materials" and subsequent circulars dealing with fundamental material were published until 1929. However, for some time the Society had recognized the need for a compact handbook which would provide a use reference source. For this purpose, the loose-leaf style proved inconvenient and, in 1932, the first bound volume of the REFRIGERATION DATA BOOK AND CATALOG made its appearance. New editions of this engineering handbook on basic principles were published biennially since, with a second volume, REFRIGERATION APPLICATIONS, first appearing in 1940 and published in alternate years. Each volume was carefully revised, edited and brought up to date in line with current developments and changes in practice.

The last issues of these volumes appeared in 1958 (10th edition – design volume of AIR CONDITIONING AND REFRIGERATING DATA BOOK) and 1959 (REFRIGERATION APPLICATIONS). For each volume, more than 10,000 copies were distributed. Sections of the 1959 book concentrated upon Refrigerated Food and Beverage Processes; Frozen Food Processing; Refrigerated Warehouse Practice; Refrigerated and Frozen Food Distribution; Low Temperature Applications; Industrial Applications of Refrigeration; Refrigeration Piping Systems; and supplemental items.

1961 BEGINS A NEW ERA

The merger of ASHAE and ASRE into the AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE) has enabled the Society to give the engineering profession and industry a greatly expanded scope of study and research. The merger has also brought about a consolidation in the publishing of the engineering handbooks. Currently, in the hands of the editors is material for the first of two volumes. The first volume on Fundamentals and Equipment will appear in 1961; the second, on Applications, in 1962. In subsequent years, these books will be revised and up-dated. The Society is publishing these books in quantities of 30,000, approximately 20,000 for the membership and 10,000 for non-members.

The 1961 volume will contain 800 to 900 pages of technical text and 400 to 475 pages of advertising. It will have the same appearance and be the same size as the 1960 GUIDE, thereby emphasizing the continuity of the Society's publications. In addition to sections on Theory, Materials, Load Calculations, Refrigeration, and Codes and Standards, Volume I – 1961 will also contain sections describing System Components, Unitary Refrigeration Equipment and Air-Conditioning Units. The advertising pages will permit the user of the book to find complete information on these products as made by different manufacturers.

GUIDE AND DATA BOOK

The GUIDE AND DATA BOOK COMMITTEE, formerly a sub-committee of the PUBLICATIONS COMMITTEE, has been reorganized into an independent and free-standing committee to direct the future of the Guide and Data Books. Although the books will acknowledge in their prefaces the names of those individuals who have been most active in the preparation of the chapters, there will be many others who will have assisted in various ways to supply information and establish the books' authority.

A. J. Hess, the first president of ASHRAE, has stated: "The GUIDE has become the 'bible' of the industry and one of the most respected publications of any technical society." It is the mission of the GUIDE AND DATA BOOK COMMITTEE and of the entire Society to make the new volumes both authoritative and indispensable to all those engaged in the fields of Heating, Refrigerating, Air-Conditioning and Ventilating.

ASHRAE NATIONAL MEETINGS AHEAD	1961	1962	1963
	Feb. 13-16 Semiannual Chicago, Ill.	Jan. 28-Feb. 1 Semiannual St. Louis, Mo.	Feb. 11-14 Semiannual New York N. Y.
	June 26-28 Annual Denver, Colo.	June 25-27 Annual Miami, Fla.	

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Subcommittee on the Evaluation of Hermetic Motor Insulation	R. T. Divers R. C. Burns

AMERICAN MEAT INSTITUTE

ASHRAE-AMI Meat Packing	K. E. Nielsen, Chairman E. N. Johnson B. C. McKenna C. D. Macy F. P. Neff K. E. Wolcott

AMERICAN PUBLIC HEALTH ASSOCIATION, INC.

Committee of Hospital Facilities Engineering and Sanitation Section	L. J. Pecora

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Plant and Animal Husbandry	M. K. Fahnestock

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

PTC-23 Atmospheric Water Cooling	A. L. Hesselschwerdt, Jr.
PTC-25 Safety and Relief Valves	M. M. Garland

AMERICAN SOCIETY FOR TESTING MATERIALS

A-5 Corrosion of Iron and Steel	B. A. Phillips
B-3 Corrosion of Non-Ferrous Metals and Alloys	R. C. McHarness
C-16 Thermal Insulating Materials	C. F. Kayan E. R. Queer
D-2 Petroleum Products and Lubricants	E. S. Ross
D-3 Gaseous Fuels	E. A. Norman, Jr.

CANADIAN STANDARDS ASSOCIATION

Safety Code for Hospital Hazards	J. Klassen

INTERNATIONAL ORGANIZATION OF STANDARDIZATION

Advisory Committee to ASA on ISO/TC 86 Refrigeration	A. T. Boggs, III Leon Buehler, Jr. W. A. Grant H. O. Klarer J. R. Schreiner T. B. Simon W. E. Ural R. L. Williams

NATIONAL ACADEMY OF SCIENCES—NATIONAL RESEARCH COUNCIL

Division of Engineering & Industrial Research	E. R. Queer
US National Committee of International Institute of Refrigeration	D. D. Wile
Office of Critical Tables, Advisory Board	C. F. Kayan

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

Intersociety Corrosion Committee	B. A. Phillips F. N. Speller

NATIONAL FIRE PROTECTION ASSOCIATION

Hospital Operating Rooms	R. P. Gaulin Alternate: N. Glickman
Air Conditioning	A. I. McFarlan
Blower Systems	W. S. Bondy

Chicago Will Be Host for ASHRAE 1961 Semiannual Meeting

Preliminary planning, for the ASHRAE Semiannual Meeting to be held in Chicago, February 13-16, 1961, has resulted in a particularly well-balanced technical program, a diversity of Symposiums and a somewhat different plan for Forums. Individual papers have not been scheduled definitely, but on Monday, February 13, there will be a Technical Session on Combustion and another upon Insulation. On the same day there will be a Symposium in regard to Frozen Foods.

Refrigeration will be the subject of the Technical Session on Tuesday accompanied by two Symposiums, one on Heating and the other on Air Conditioning. Wednesday will bring a special session for the delineation and discussion of the Research and Technical Program and plans of the Society. On this day, there will also be a Symposium on Domestic Refrigerator Engineering.

The last day of the Semiannual Meeting will have a session rounding up several significant general subjects as well as a Symposium on Ventilation.

Heretofore, Forums have been held concurrently, or at least in the same afternoon; this time there are planned a possible total of six to be divided over Monday, Tuesday and Wednesday.

Reported activities and programs for the 15th International Heating and Air-Conditioning Exposition to be held concurrently with the ASHRAE Semiannual Meeting already indicate a large, if not record-breaking number of exhibitors.

Preliminary correspondence foretells that when room reservations at the Conrad Hilton Hotel are assigned there may be a new high in attendance involved. It is currently estimated that more than 3000 members and guests will have registered for this notable ASHRAE Meeting.

CHAPTER AND REGION NEWS

(*Continued from page* 73)

On October 4th, two films were presented, "The Nature of Balancing," shown by William Schmidt of Gisholt Machine Company, and a short film on the analogy of sound light and electrical waves, supplied by Bell Laboratories.

COLUMBUS . . . Coffee talk speaker at the September 19th meeting, first of the season for this Chapter, was James H. Downs, Director of Region V, who spoke on chapter activities throughout the region. Main speaker of the evening was R. H. Tull, First Vice President, ASHRAE, who discussed National committee activities, progress on the national level and operations of the Society.

NIAGARA FRONTIER . . . Stressed by Z. A. Marsh, Director of School Activities for Minneapolis-Honeywell, at the September 19th meeting, was the fact that a school designed for and with air conditioning from the start costs no more than a conventional school designed with extensive window areas for natural ventilation.

Program for the October 10th meeting featured Prof. Paul E. Mohn of the University of Buffalo, who presented a report on gas and electric heating systems in the Angola schools. A discussion period of some length followed.

PITTSBURGH . . . To illustrate "Influences of Connections on Fan Performance," William E. Tracey of Westinghouse Electric Corporation, speaking at the September 19th meeting, set up a demonstration using an actual fan with discharge duct, pitot tube and an indicator which showed relationships of hp, volume and pressure. Using this equipment, typical fan performance and system curves were plotted. By adding various inlet and outlet connections to the fan, the effect on performance was shown and recorded on an enlarged projected slide.

WESTERN MICHIGAN . . . "What is gas air conditioning?" was asked by Dr. Eugene Whitlow of Whirlpool Corporation, speaking at the September 12th meeting, first of the new season for this Chapter. Stating that terminology has been refined to apply to air conditioning by natural gas used on the site, speaker Whitlow went on to discuss the two types of systems utilized in gas air conditioning, absorption and heat engine and compressor. Diagrams were used to explain method of operation, advantages and disadvantages of each type of system.

EL PASO . . . Plans were made at the September 19th session for a joint meeting with New Mexico Chapter, proposed for October 21st. Included in the meeting was to be a tour of White Sands Proving Grounds.

MONTREAL . . . "The Place of the Engineer in Society," topic under discussion at the September 19th meeting, was presented by William Riley, past-President of the Professional Engineers of the Province of Quebec. Prime purpose of the engineer, stated speaker Riley, is to apply the sciences for the good of mankind and the protection of the people. Problems confronting individual engineers in large organizations were noted by him.

ST. LOUIS . . . Program for the evening of September 19th was a panel discussion on "Problems and Solutions on Central Systems for Air Conditioning." Speaking were Cecil Drake, architect, as Moderator; Lester Gross, contractor; Louis Hamig, engineer; Bud Meyers, manufacturer; and Wayne Stout, public utility. Main issues discussed were fan coil units, induction units, controls, installation costs and efficiency of air filtration.

NORTH ALABAMA . . . Guest speaker at the September 8th meeting was Paul E. Bartels of Alco Valve Company, who discussed "Valve Applications to Heat Pump Jobs." Emphasized was how development of three and four-way reversing valves made automatic control of heat pumps possible. Further discussion concerning the difference between "Poppet" and "slide" type valves covered cost and application. Following his talk on valve design, speaker Bartels showed a series of slides on the many types of heat pump systems and various ways of piping these systems.

NORTHERN CONNECTICUT . . . Highlighting the first meeting of the season was a tour of Kimberly-Clark Corporation's New Milford plant. Guiding members through the installation, Carl Pennau, Staff Superintendent, explained in detail special applications required of the air conditioning system. Quintin Narum, also of Kimberly-Clark, described steps taken to assure the high degree of control of the air conditioning system required in manufacture of paper.

WISCONSIN . . . Leon Buehler, Chief Refrigerating Engineer with Creamery Package Manufacturing Company, spoke at the September 19th meeting on "Refrigerating Compressors." His talk was a general discussion of the various types of compressors and their respective applications.

MICHIGAN . . . Both refrigeration for food preservation and air conditioning for comfort are indispensable to successful operation of atomic submarines. Without them the record-breaking underwater cruises could not have been made, according to Eugene H. Honegger of the Department of the Navy's Bureau of Ships, speaking at the September 19th meeting. Stressed in his speech were problems of planning, designing and scheduling these vessels.

NORTHEASTERN OKLAHOMA . . . Heat pump system designed for the Oklahoma Gas & Electric Company building in Oklahoma City was discussed by Neil Hill of Sorey, Hill and Sorey, designers of the system. Throughout his speech he emphasized

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CHAPTER AND REGION NEWS

(*Continued from page* 86)

that basically standard equipment was used for this installation.

General divisions of speaker Hill's address were description of the building and the system, discussion of heat pumps in general and their application in multi-story buildings such as the one cited, design considerations, capabilities and limitations of the system as analyzed by the engineers and found in actual practice after the building was completed, a detailed description of the heat pump system and the part played in the system by each piece of equipment, and control methods.

CHAPTERS REGIONAL COMMITTEE MEETINGS AHEAD

REGION VI, Iowa Chapter (Des Moines), Nov. 2

REGION VII, Kansas City Chapter (Kansas City), Nov. 3

OUR ENVIRONMENTAL PROGRAM

(*Continued from page* 54)

ronment program for the Society was prepared in 1957 as a culmination of recommendations from Advisory Committees, with help being given in preparing the program by Nathaniel Glickman, who served as a consulting physiologist. The Annual Report of the Committee on Research for 1957 described this program in the following terms:

Program I. Influence of the Thermal Environment on the Comfort of Sedentary Workers. This program will be carried out first, primarily to re-evaluate certain of the data and values and their relative allocation on the comfort chart of the Society.

Program II will extend the objectives of Program I and introduce variations of radiant wall temperatures, so that the effect of symmetrical, as well as asymmetrical radiation can be studied over wide variety of conditions.

Program III. Optimum Conditions for Comfort at Different Levels of Work. This program will endeavor to determine the desirable comfort ranges at varying work levels.

Program IV. Human Productivity or Occupational Efficiency. This is one of the more difficult researches to carry out, as it will have to measure the effects of environment on productivity. It is thought to be axiomatic that an occupant in an uncomfortable environment not well adapted to his physiological needs will perform less effectively than a person in a more suitable environment.

Program V. The Comfort of School Children as Related to Learning Rates. The nature of this study is obvious from its title.

To date work has largely been confined to parts I and II of the original outline. It was not expected that the determination of fundamental environmental data could ever take place at a rapid rate, as it is necessary to use human subjects as technical indicating devices, ultimately to give a quantitative evaluation of human response to a given set of conditions. Unfortunately, the human being as a scientific instrument leaves much to be desired as responses are affected by psychological and physiological parameters to a degree almost impossible to believe. Consequently, it is necessary to check and recheck every series of investigations until statistical reliability is assured. The Laboratory has been fortunate in having a physician and physiologist, Walter Koch, on its staff to work with the engineering group on the conduct of the research program.

As has been noted, the current program has completed and published two studies dealing with lightly-clothed, sedentary, inactive individuals in the comfort range and in the adjacent hot range. Further work in progress, but not yet completed, has carried this study further ahead with the introduction of radiation as a variable. The Research and Technical Committee at the present time is in process of planning the details of future environmental research by the Society and as this material is planned for early presentation to the Society, it appears premature to discuss it further at this point. It is obvious from the preceding discussions that our industry is still faced with a number of problems for which answers must be obtained and the complexity of these problems indicates that no short-term program will suffice. The Laboratory will endeavor to produce, as rapidly as possible, a continuing supply of information for use by our industry.

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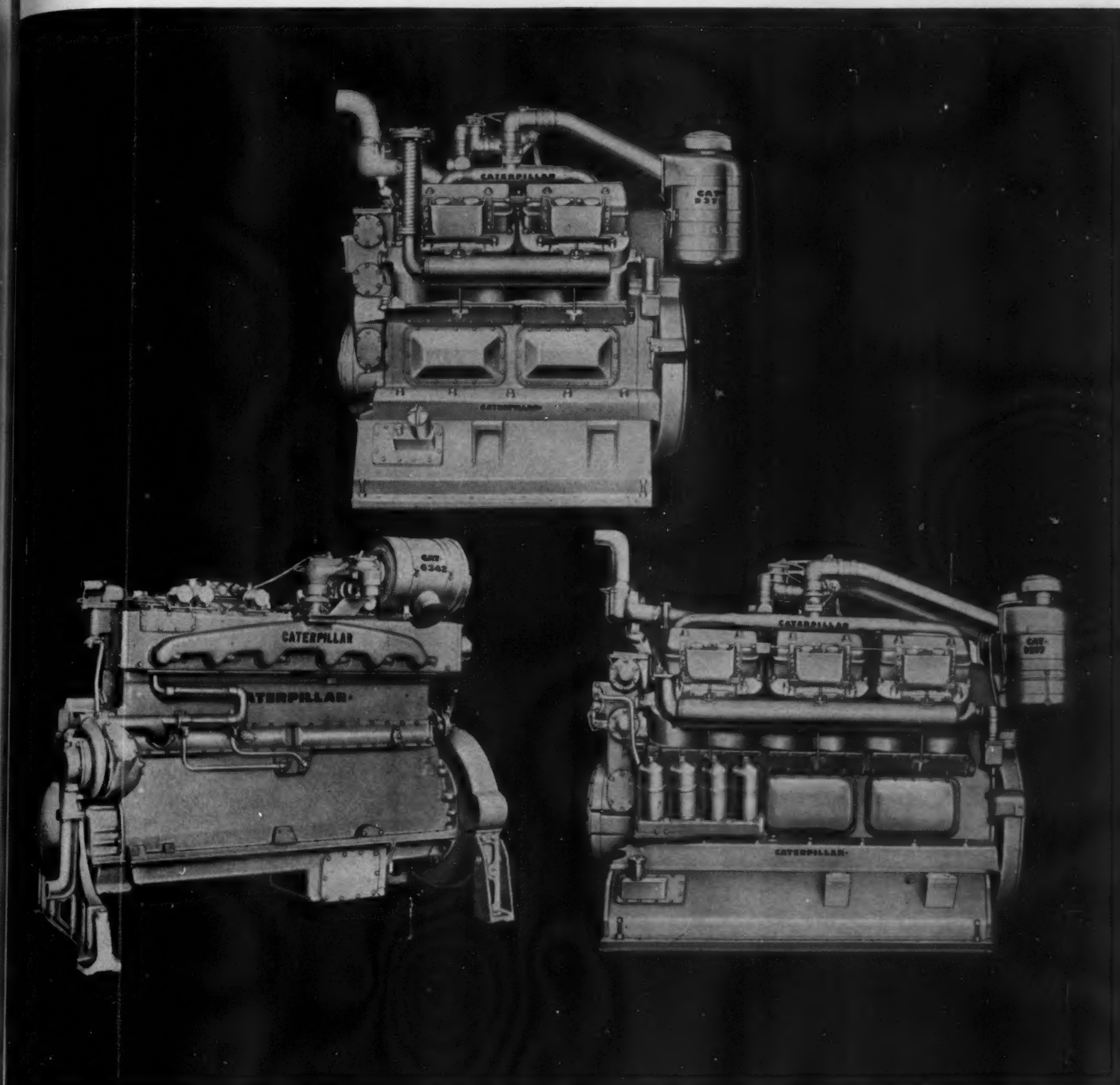


If Air Conditioning Costs Seem High, Better Consider a CAT Natural GAS Engine!

Now, gas can efficiently cool a skyscraper — a sprawling factory — a supermarket — or an office building — by converting gas into mechanical power with a Cat Natural Gas Engine!

Today, in many areas, gas provides the lowest cost of all power sources. Combine the economy of gas as a fuel with the efficiency of Caterpillar Natural Gas Engines, and your clients can take advantage of this low cost cooling system.

Caterpillar's exclusive 10.5:1 compression ratio engines have been developed with economy in mind. Performance proves they can help your clients realize as much as 26% savings in fuel costs compared to other engines in their power range!

Proven by millions of working hours on the world's toughest jobs, Cat Natural Gas Engines have the strength and durability to run continuously under full load, indefinitely, without derating.

Modern commerce and industry demand absolute dependability in their air conditioning. You can provide them dependability plus capacity and economy by specifying gas cooling with Caterpillar Natural Gas Power. For full technical details, call your local Gas Company, or write Industrial Engine Division, Caterpillar Tractor Company, Peoria, Illinois. *American Gas Association*

FOR COOLING AND HEATING ...GAS IS GOOD BUSINESS!

BULLETINS

Vertical Check Valve. Originally designed for use in service stations, these valves now are applied more widely, being used wherever it is necessary to maintain a prime in liquid lines. In operation, the disc swings completely out of the flow passage for min pressure drop. When flow stops, the disc swings downward to a raised seat. A compensator ring provides even pressure on all sides of the disc against the seat, eliminating uneven seating or loss of prime. Flyer NP 16 E describes features and materials of construction and contains illustrations, a flow chart and extensive engineering information.
OPW - Jordan Corporation, 6013 Wiehe Rd., Cincinnati 13, Ohio.

Filter, Regulator and Lubricator Bulletin. Providing complete catalog listings as well as simplified engineering and application data on Crown filters, regulators and lubricators, 20-page Bulletin 0400-B1 replaces four separate bulletins. Each unit is diagrammed and is accompanied by dimensional drawings and tables. A parts identification section also is included.
Hannifin Company, 501 S. Wolf Rd., Des Plaines, Ill.

Industrial Vent Pipe. Advantages and properties of Transite industrial vent pipe, as well as engineering data, are described in 20-page Bulletin TR-237A. Introductory section of the booklet, addressed to engineers, discusses properties of the pipe, such as corrosion and weather resistance and low friction coefficient, and relates them to specific advantages. Pipe sizes and dimensional information in tabular form are provided in a separate section. Couplings and fittings are treated by types with exterior and interior views shown. Proper applications of jointing compounds are furnished with a listing of suggested quantities, along with recommended flexible fan connections and specific hanging and bracing information.
Johns-Manville Corporation, 22 E. 40th St., New York 16, N. Y.

Couplings. Designed solely for use in permanent piping, Rigid-Line couplings are the subject of a newly-issued flyer. Units are used for quick addition or removal of relief, flow control or check valves in permanent hydraulic or pneumatic installations. Listed in the bulletin are two sizes available in three finishes and three metals. This series also is available with a choice of four end fittings and with any of eight seals.
Snap-Tite, Inc., Union City, Pa.

Circular Duct Silencers. Four-page Bulletin B10 includes, in addition to description and illustrations of the product, a selection chart and tabular information on airflow vs. pressure drop and noise reduction values. Two models, with normal and low pressure drop, are available.
Silence, Inc., P. O. Box 21, Farmingdale, N. Y.

Expansion Joints. For hot water and steam heating installation on straight baseboard runs of 25 ft or more for water temperatures ranging from 100 to 250 F, these expansion joints have a max pressure rating of 45 psi for hot water and 15 psi for steam applications. Flyer 900-60.
Modine Manufacturing Company, 1500 DeKoven Ave., Racine, Wisc.

Refrigerator and Freezer Line. Descriptive of this line of self-contained and remote reach-in refrigerators, dual-temperature refrigerators, upright freezers and wall-type refrigerators is a six-page bulletin. Units feature door

storage shelves and a streamlined blower coil for extra storage space.
Silver Refrigeration Manufacturing Corporation, 1469 Utica Ave., Brooklyn 34, N. Y.

Fabric Filter. For industrial dust collection, this filter features high efficiency, max flexibility, low installation cost, min maintenance and max fabric life. Filter bags, both tubular and envelope types, are available in a variety of fabrics with high temperature ranges. Bulletin 150, four pages.
John Wood Company, Air Pollution Control Div, Bernardsville, N. J.

Precalibrated Controls. Dual-Mite controls are calibrated at the factory to provide heat control up to 350 F, eliminating necessity of further setting or adjustment prior to installation. Design information is presented in a flyer.
Thermal Engineering & Design Company, 217-223 Ash St., Akron 8, Ohio.

Vacuum Diffusion Pumps. Contained in a 12-page catalog are basic descriptive information on diffusion and booster pumps; speed curves for small, medium and large models ranging from one to 32-in. sizes; and tabular specifications and outline drawings for each pump. Special information on the theory of diffusion pumps and their operation at low pressures is also included.
NRC Equipment Corporation, 160 Charlemont St., Newton 61, Mass.

Sound Control Products. Twenty-page Catalog 61 presents an extensive listing of sound absorptive, sound isolating and special purpose acoustical materials. Pictorial presentations of all products is coupled with general and technical descriptions, including sound transmission loss and other functional data.
Elof Hansson, Inc., Acoustical Div, 711 Third Ave., New York 17, N. Y.

Warm Air Heaters. Descriptive of Thermobloc warm air heaters for industrial and commercial use, eight-page Bulletin 43-11 contains plan and dimension drawings of all models, as well as halftone illustrations. Specifications for both gas and oil-fired units are listed.
Wanson Corporation, Lewistown, Pa.

Pipe and Block Insulation. Six-page Bulletin 6472 lists pertinent data concerning calcium silicate industrial insulation for temperatures up to 1350 F. Heat transmission data, physical and thermal characteristics, standard sizes and recommended thicknesses are presented in tabular form. Prod-

uct description includes factors concerning insulation efficiency, ease of handling, high impact strength, flame and water resistance, dimensional stability and resiliency.
Philip Carey Manufacturing Company, 320 S. Wayne Ave., Cincinnati 15, Ohio.

Baseboard Heating Equipment. Included in a new product program announced by this manufacturer is an extensive line of forced hot water baseboard heating equipment, described in six-page Bulletin 360. Units are installed ankle-high at room perimeters to offset heat loss. No grilles are used, air entering a continuous opening at the floor line, passing over the heating element and flowing out through a continuous opening at the top.
Modine Manufacturing Company, 1500 DeKoven Ave., Racine, Wisc.

Flexible Hose. Detailed descriptions, specifications, applications and coupling recommendations are given for U-200 and U-250 Series hose, utilized for conveying searching gases and fluids such as steam, hot oil, liquefied gases and refrigerants in installations where completely leakproof hose construction is essential. Also discussed in 20-page Catalog ID-100D are U-150 Series general purpose industrial hose, suited for non-searching fluids; Steelflex standard, light, medium, heavy and superweight galvanized steel, all-metal flexible exhaust and blower tubing; galvanized steel and corrugated all-metal flexible diesel engine exhaust tubing; Stay-Put Economy and Full-Flo aerator coolant nozzles; and LP steam connectors.
Universal Metal Hose Company, 2133 S. Kedzie Ave., Chicago 23, Ill.

Air Duct Calculator. Pocket-sized and having but a single slide, this calculator simplifies duct sizing by equal-friction or velocity-reduction methods, as well as estimating metal and insulation requirements. Data which may be read with a single setting of the slide include friction per 100 ft of duct, cfm, velocity in fpm, round duct diam and rectangular equivalents in in., weight per lineal ft of round duct in lb for various gauges of galvanized and aluminum duct and surface area in sq ft per lineal ft of round duct. Calculator is priced at $2.50.
Paul S. Morton Engineering Service, 5131 Meadowlark Lane, Kalamazoo, Mich.

Saddle Fittings. Four-page Bulletin 5-60 presents extensive information on this line of fittings, including product description, illustrations, specifications, ordering instructions and testing data. Welding lateral dimensional data is given in an appended flyer.
Allied Piping Products Company, Inc., 201 S. Broadway, Camden 3, N. J.

Air Filter. Foamat, a unit air filter utilizing a single sheet of synthetic plastics material, is the subject of four-page Bulletin 208. Sponge-like in appearance, the filter breaks an air stream into small jets, trapping dust and dirt in the cells. Designed as a permanent filter, it will not pack, settle, separate or develop thin spots.
American Air Filter Company, Inc., 215 Central Ave., Louisville 8, Ky.

Pressure and Temperature Controllers. Controlling pressures to 10,000 psi and temperatures from −125 to 1000 F, these pneumatic controllers are simple, self-contained and give precise response (1% middle half of scale.) Corrosion resistant materials are used throughout. Standard features, as discussed in six-page Catalog J-C, include 1 to 100% proportional band, manual reset, differential gap action and on-off snap action. Remote set-point, control by-pass and automatic reset or rate are available as required. Temperature controllers are

manufactured in both indicating and recording models. Rounding out the line are transmitters and recorders. Features and accessories are described and dimensions, specifications, materials of construction and extensive engineering data are detailed.
OPW-Jordan Corporation, 6013 Wiehe Rd., Cincinnati 13, Ohio.

Return Line Corrosion. Discussing how causes of corrosion can be identified readily and then corrected, this water conditioning data sheet, "Return Line Corrosion Need Not be a Problem," covers oxygen and carbon dioxide attack and neutralizing and filming amines. Flyer is illustrated.
Betz Laboratories, Inc., Gillingham & Worth Sts., Philadelphia 24, Pa.

Wire Mesh Filter Assemblies. Twenty data sheets, describing more than 225 items in twenty basic types of standard woven wire mesh element-in-line filters, are available. Each of the series shows a cross-sectional view of the filter element and housing. Working pressure, temperature ranges, port sizes and other significant factors are listed for each type shown. Tabular information includes part number, port type and size, rated flow, pressure drop and particle removal ratings. In addition, optional variations are shown for each basic type, allowing many combinations for varieties of applications.
Aircraft Porous Media, Inc., a subsidiary of Pall Corporation, 30 Sea Cliff Ave., Glen Cove, N. Y.

Steel Pipe and Tubing. Six-page Bulletin T-467 contains information on fifteen steels widely used in high temperature service. Included is a chart containing data on tensile properties, thermal conductivity and expansion, creep strength, oxidation resistance and other such mechanical and physical properties of importance to application engineers.
Babcock & Wilcox Company, Tubular Products Div, Beaver Falls, Pa.

Receiver Gauges. Special-purpose low pressure units used to indicate values transmitted by pneumatic signal from a remote location, usually in the range of 3 to 15 psi, dial indicating receiver gauges are the subject of eight-page Catalog 520. Specifications are given for both bourdon tube and diaphragm-actuated types and information is presented on materials, dials, ranges and case styles and sizes. Tables give selection data.
United States Gauge Div, American Machine & Metals, Inc., Sellersville, Penna.

Panelcoil Applications. Uses of single and double-embossed Panelcoil for heating and cooling are illustrated in their extended applications for storage and processing tanks, drums, troughs, ovens and other processing equipment, in Flyers M12 and M13.
Dean Products, Inc., 1048 Dean St., Brooklyn 38, N. Y.

Balancing Valve. Taking the place of two valves normally used in series on the return line of a water coil, this dual-purpose hot water balancing valve, described in four-page Bulletin 204, effects economies in installation. Adaptable to most heating and cooling water applications, the unit has efficient balancing characteristics and provides a tamper-proof feature, allowing balance position to be fixed and permitting the valve to be closed and opened to the predetermined balance point and no farther.
American Air Filter Company, Inc., 215 Central Ave., Louisville 8, Ky.

General Catalog. Information presented in 32-page Catalog 160 includes a brief history of the company, an illustrated description of the plant

(*Continued on page* 106)

CAPILLARY TUBES
a proposed ASHRAE Bulletin

To make available generally the full text of the Chapter on Capillary Tubes, as prepared originally for the 1961 ASHRAE GUIDE AND DATA BOOK but subsequently reduced considerably in length for actual publication therein, there is planned tentatively a special ASHRAE Bulletin.

This will include the original full text and all illustrative material.

Authoritative, detailed and following GUIDE form, this Bulletin has been authorized by the ASHRAE Publications Committee **but only to be made available if enough pre-publication orders are received to justify the project.**

Please indicate below if you are interested in this Bulletin at the prices indicated; which vary only to reflect the total quantities that may be printed.

NAME ....

ADDRESS ....

I am interested in the proposed Capillary Tube Bulletin and would accept a charge of $1.50 or $3.00.

SIGNATURE ....

Applications

FARMERS MARKET TEMPERATURE CONTROLLED

One-fourth of the 510,750 sq ft of fruit and vegetable dealers' space in the State Farmers Market at Atlanta, Ga., is refrigerated. Two large restaurants are air conditioned and air handling units provide comfort conditions in other public areas of the 146-acre facility.

Approximately 180 ton of refrigeration are supplied by Recold ceiling coils and air-cooled and evaporative condensers. Of this load, 25 ton are provided by special ceiling mounted units with reheat coils for a large banana room application.

SYSTEM TO REDUCE SCHOOL HEATING AND VENTILATING COSTS

Operating on the principle of high velocity induction, this system, to be installed in two schools under construction in upstate New York, is expected to reduce heating and ventilating costs as much as 10%. In each case, provision will be made to add cooling later.

While similar to the forced warm air systems commonly found in homes, this Carrier Corporation development differs in that more air is circulated and each outlet contains a coil for reheating room air induced through it. This reheat coil acts like a baseboard convector at night and during week-ends, reducing operating costs by eliminating the need to send warm air into the rooms from the central system during these periods.

First installations will be in the 850-student Batavia Senior High School and 800-student Hurlburt W. Smith Junior High School in East Syracuse.

BUSES FEATURE AIR CONDITIONING

Continental Trailways Bus System's new 63-passenger "Super Golden Eagle" buses are air conditioned for comfort on transcontinental runs. Temperature in the 60-ft, two-section vehicles is maintained at a constant 74 F by Carrier reciprocating refrigeration units of 15-ton cooling capacity.

900-TON COOLING FOR UEC BUILDING

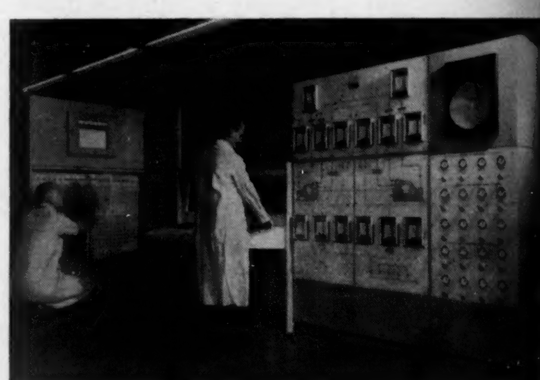
Comfort cooling for the United Engineering Center, under construction at United Nations Plaza in New York City, will be provided by 900 ton of refrigerating capacity. Comprising the system will be a 600-ton Carrier absorption refrigeration machine and a 300-ton turbine-driven centrifugal refrigeration unit. Tandem arrangement of these units affords the added economy of enabling the steam supplied by Consolidated Edison to be used twice. Steam will drive first

the turbine compressor of the centrifugal machine and then will supply heat energy necessary for operation of the absorption machine. Carrier By-Pass Weathermaster units, which have a factory installed and balanced control powered by high velocity primary air supplied to the unit, will proportion the air flow through the cooling-heating coil while the water flow remains constant. Since the temperature controller is now in each unit, there is greater flexibility afforded in placement of room partitions and varying requirements can be met in different areas at any given time.

51 AIR-HANDLING SYSTEMS TO SERVE BANK BUILDING

Providing comfort for Manhattan's new 64-story Chase Manhattan Bank building, 51 air-handling systems will circulate two million cfm of temperature-controlled air day and night. Compounding the air conditioning requirements are 8800 windows with an area of 800,000 sq ft; lights alone will radiate 17 million Btu/hr. Peak heat output from the building is estimated to be more than 275 million Btu/hr. To handle this load, the building will have 9100 ton of cooling capacity. Two Carrier refrigeration units will handle five subbasements and the first 21 floors and two will serve the top floors. Each floor has a four-zone interior system supplemented by a perimeter system. In both systems approximately 3000 Minneapolis-Honeywell thermostats will sense and control temperatures.

Medium-velocity, medium-pressure air is used in the interior system. Temperatures for each zone on every floor are controlled individually to compensate for sun, wind, interior heat load and other factors. Eighteen perimeter systems circulate high-pressure



air at high velocity through 7000 induction units. Air from the units is mixed with room return air in an approximate 1:5 ratio.

In winter, water circulating through the induction coils will be at 90 to 110 F; in summer, approximately 60 F. Low pressure air will be circulated through ceiling diffusers on the five basement levels. All air for the building will be treated by electronic air cleaners.

Controlling the system will be two Honeywell Selectographic DataCenters (shown), one on the 11th floor to handle the lower part of the building, the other on the 31st floor to serve the upper stories.

BULLETINS

(*Continued from page* 100)

location, facilities and services, and an extensive product resume with installation photographs. A presentation of nuclear heat transfer applications, stressing technical research developments, completes the contents.
Young Radiator Company, Racine, Wisc.

Copper Pipe and Tube Products. Included in 64-page Bulletin B-1 are information, tables and other data on copper piping used in plumbing, heating, air conditioning and refrigeration. Included in the table of contents are such subjects as water pipe corrosion, suggestions for making soldered and brazed joints, procedures for making joints with flared-tube fittings, industrial piping and fittings for copper tube.
American Brass Company, Waterbury 20, Conn.

Mechanical Power Transmission Equipment. Described and illustrated in eight-page Catalog 23103 is this company's complete line of mechanical power transmission equipment. Products covered include variable speed drives of both motion and stationary control types, conventional V-belt and Ultra-V-belt drives, timing belt drives, flat belt pulleys, flexible and rigid couplings, adjustable motor bases, ballbearing pillow blocks, flange and take-up units, solid and split sleeve pillow blocks, cotton-card drives, cotton cleaner drives and bushings.
T. B. Wood's Sons Company, Chambersburg, Pa.

Flexible Shaft Handbook. For design engineers and users of flexible shafts, the Fourth Edition of this 96-page handbook has been revised extensively. Featured among new data is a simplified approach to selection of standard, pre-engineered or custom-designed shafts. Descriptive material, charts, tables and drawings are provided, together with information on a simplified engaging system based on integral formed square drives and Series 7 (remote control) and 9 (power drive) flexible shafts. Discussed in detail are advantages, function, application and features.
S. S. White Industrial Div, Dental Manufacturing Company, 10 E. 40th St., New York 16, N. Y.

Heating Manual. Product illustrations, specifications, cooling coil capacities and general information on the manufacturer's Commercial-Aire and Compact-Aire lines of heating, cooling and ventilating equipment are provided in the series of bulletins and data sheets comprising this Heating Manual.
Mammoth Furnace Company, 6425 Cambridge St., Minneapolis 26, Minn.

Wire Construction. Principal types of wire available for component construction, finishes, wire sizes and the variety of end, threading and forming treatments available are discussed in a 24-page manual. Featured are case histories of applications utilizing wire and strip metal components.
E. H. Titchener & Company, 57 Clinton St., Biinghamton, N. Y.

Subminiature Switches. Contained in 16-page Catalog 20-1 is information on an expanded line of subminiature switches. Listings include high-temperature, sealed, environment-free and MIL-Specification type switches as well as styles of phenolic-cased, push-button, toggle and integral-actuator units. Five different terminal styles and a wide variety of multiple-switch actuator combinations are presented. Shown in a pictorial index are location of dimension drawings, descriptions, force and movement specifications, electrical ratings and a photograph for each switch listed. Data on terminal and circuit arrangements and standard definitions of terms are also included.
W. L. Maxson Corporation, Unimax Switch Div, Ives Rd., Wallingford, Conn.

Blast Coil Heaters. Features of revised and enlarged 32-page Catalog E-97U on electric blast coil heaters for duct installation include listings of heaters and accessory equipment, special constructions and description and application information. Units described are intended for use as primary heat, supplemental heat with heat pumps and auxiliary heat for zone control.
Industrial Engineering & Equipment Company, 24 Hanley Industrial Ct., St. Louis 17, Mo.

Insulation Installation. "How to Install Mineral Wool Insulation in Homes" is a 36-page booklet prepared as a guide to approved application practices. Illustrated instructions for installing batts and blankets and blowing wool are given. Explained is the newly installed resistance standard, which aids users in determination of how any mineral wool product will perform after it is installed.
National Mineral Wool Association, 1270 Sixth Ave., New York 20, N. Y.

PARTS and PRODUCTS

PACKAGE GENERATORS

Fired either by oil, gas or gas-oil, the twelve sizes in the WhirlPower 33 Series are designed for commercial and light industrial installation. Rated steam or hot water output ranges from 355,000 to 2,009,000 Btu/hr and from 10.6 to 60 hp. A three-pass low pressure unit utilizing principles of sealed combustion and forced draft, the generator is cited as having efficiency in excess of 80%, low head room and min standby loss. Eliminated are refractory sidewalls in the firebox, effects of draft irregularities, high stacks, ID fans and high boiler base. Each boiler is designed for 15 psi steam or 30 psi water and is tested hydrostatically at 60 psi.

Iron Fireman Manufacturing Company, 3170 W. 106th St., Cleveland 11, Ohio.

PROTECTIVE COATING

Used to minimize corrosion of metals in production processes, storage and shipment, Soft-Seal penetrates grain boundaries, cracks and pores to form a continuous protective film from one to eight micron thick. Applied by spray or immersion, the coating is cited as being equally effective on iron, steel, aluminum, magnesium and plated finishes. Harmless to painted surfaces and easily removed with live steam or solvents, it does not harden, dry out or become brittle.

Corrosion Reaction Consultants, 116 Chestnut St., Philadelphia 6, Pa.

WHO'S WHO IN ASHRAE

Insofar as possible, these listings will each appear twice a year

ASHRAE OFFICERS, DIRECTORS, COMMITTEES, STAFF

See page 78, October JOURNAL

REGION AND CHAPTER OFFICERS

See page 82, this issue

RESEARCH AND TECHNICAL COMMITTEES

See page 67, September JOURNAL

STANDARDS PROJECTS

See page 63, July JOURNAL

INTER SOCIETY COMMITTEES

See page 84, this issue

VALVE AND TANK

For hydronic systems, Fill-trol is a packaged combination of a fill valve and pressurized diaphragm-type expansion control tank. Holding to its pressure setting and featuring fast fill and positive shut-off without leak-by, the bronze-bodied valve is provided with union connection, ball check, screen and manual shut-off. Pressure setting is adjusted easily by changing the charge pressure in the tank, which also provides a permanent expansion cushion.

American Tube & Controls, Inc., Box 329, West Warwick, R. I.

WATER COOLER

Introduced a year ago, the Wall-Temp drinking water cooler is now available in two capacity ratings. Model WT-6, delivering six gph, has been added as a companion model to WT-13 (13 gph). Units mount flush to the wall and off the floor, with plumbing concealed within the cabinet.

Temprite Products Corporation, Birmingham, Mich.

THERMOMETERS

Three dial indicating thermometers for industrial applications offer, among other new features, crowned acrylic lens for max light on dial, raised graduations to reduce parallax error, adjustable bracket allowing for mounting variations of 150 deg on horizontal axis, 90 deg rotation of case in either direction on vertical axis, adjustable pointer and sliding union connection nut that allows three to fifteen-in. immersion.

Model S is solid liquid filled and provides 270 angular deg of evenly

graduated arc. It contains no delicate geared segments, pinions or hairsprings and has pointer action on a ration of 1:1 with Bourdon system. Vapor pressure actuated, Model Y uses a single Bourdon tube and multiplying mechanism and is all nonferrous metal construction. Model B, a bi-metal thermometer utilizing a thermostatic bi-metal helix sensing element, has a stainless steel stem and connection nut.
Electric Autolite Company, Industrial Instrument Div, Port Huron, Mich.

INSHOT BURNER

Featuring a new, easily adjustable cast iron venturi, this powerful inshot gas conversion burner quickly and easily adjusts in length to fit most combustion chambers. Completely factory assembled, Model HA converts oil-fired furnaces and boilers to automatic gas heat and is equipped with a choice of 24-volt or self-generating controls. Unit may be installed in four, five or six-in. openings and will fit into even a 9½-in. enclosure. Stainless Incoloy flame spreader, cast iron mounting flange and manifold with controls are mounted permanently. An extendable push button runner lighter stretches with the venturi and a non-linting pilot burner has no holes that can become clogged. Pilot burner tubing is already connected to the pilot.

Control sizes range from one-half to one in. Min input rating is 50,000 Btu/hr and max input rating ranges from 160,000 to 225,000 Btu/hr with natural or mixed gas and from 105,000 to 225,000 Btu/hr with manufactured gas.
Adams Manufacturing Company, 1530 St. Clair Ave., Cleveland 14, Ohio.

ELECTRONIC IONIZER

Designed as a portable health appliance to provide, in one compact room unit, equipment to both cleanse and ionize air, this unit removes foreign particles and pollutants of all sizes down to less than two-millionths of an in. diam by electrostatic precipitation. In addition, the ionizer charges the purified air with negative ions.
Emerson Radio & Phonograph Corporation, Jersey City 2, N. J.

FUEL OIL CONDITIONER

Alkaline, non-corrosive, safe to handle and excellent as an emulsifier and catalyst, Kor is cited as keeping all the water, sludge and oil in complete suspension throughout the entire fuel system. As a catalyst, the conditioner increases the rate of combustion.
Kor Corporation Div, Oxi Corporation, 600 W. 9th Ave., P. O. Box 485, Gary, Ind.

INSULATION SEALER

Formulated as a barrier against condensation on insulating equipment exposed to moisture and temperature variations, Insulcap may be used on covered duct work, steam pipes, hot water lines, furnaces, breechings, converters and digesters. Resistance of the material to water, moisture vapor, acids, alkalies and general corrosive conditions give it good aging characteristics on insulating materials such as fabrics, asbestos products, glass fibers, cork board and foam glass.

Rapid release of moisture from the sealer film produces a superior adhesion without penetration. Insulcap dries to the touch within 20 min at 70 F and may be recoated within four hr.
Glidden Company, Cleveland, Ohio.

CONTROL UNITS

Extreme sensitivity and closer temperature control of reefer boxes of cargo ships are cited as being attained with application of mercury-actuated controls capable of maintaining temperatures within a variance of 1% of scale range.

Two models, designated ZS and GWS, which are non-indicating instruments, are offered. A capillary running through the bulkhead of the reefer box connects the control to the mercury-filled bulb within the refrigerated compartment. Temperature changes in the reefer box are reported through the capillary to the control instrument, activating a switch which opens or closes the valve regulating flow of coolant.
Partlow Corporation, 538 Campion Rd., New Hartford, N. Y.

DUCTLESS HOOD

Operating on the principle of electrostatic ionization, this ductless range hood removes smoke, greasy fumes, cooking odors, dust and pollen from the air. Contaminated air is drawn into the hood by blower action and the individual microscopic particles which compose the smoke and fumes pick up an electrical charge. They are then fed to a collector plate with an opposite charge, to which they adhere.
Progress Manufacturing Company, Powervent Div, Philadelphia 34, Pa.

Applications

STEAM PLANT TO HEAT AND COOL OFFICE BUILDINGS

Erected primarily to serve commercial buildings now under construction on Constitution Plaza in Hartford, Conn., a utility-operated central plant will have an initial capacity of 100,000 lb of steam per hr, which eventually will be doubled and will be equal to 6000 boiler hp. In addition to heating, the steam generated will operate refrigeration equipment capable of freezing 9000 ton of ice per day to supply chilled water for air conditioning. Housing the plant will be a 200-ft long structure, consisting of two buildings connected by a walkway. One of these will house the boilers and chilled water equipment, the other a control room and offices. A pumping system will be installed to supply river water for cooling the condensers. Use of this central plant will eliminate the need for provision of individual heating and air conditioning plants in separate buildings.

175-TON REFRIGERATION FOR WAREHOUSE

Seventeen major Recold units for air handling and temperature control produce a total of 175 ton of refrigeration for United Grocers' warehouse in Portland, Ore. Incoming produce is placed in either of two large coolers, 40 x 105 and 80 x 105 ft. Eight separate banana ripening rooms, as well as temperature and humidity controlled rooms for prepacking tomatoes, avocados and bananas, are available. Prepacking rooms can be kept at constant temperatures. Used in the installation is a new line of product coolers with centrifugal blowers, available in vertical or horizontal units for high temperature (above 34 F) or freezing-type applications with water or gas defrosting. Modular construction permits flexibility in location of blower discharge, motor and coil.

LARGE INDUSTRIAL FANS MEET NEEDS OF TEXTILE MILL

One large southern textile mill is combatting maintenance and service life problems associated with processing of synthetic fibers by use of heavy-duty industrial fans having major components made of stainless steel. Fans are American-Standard Type HS design with housings and wheels fabricated of heavy gauge Type 316 stainless steel and feature a special vibration dampener base utilizing glass fiber isolators. They are driven by electric motors through Gyrol adjustable-speed fluid drives. Use of the fluid drive here permits utilization of less expensive constant-speed motors, yet provides adjustable-speed control for efficient fan operation under varying loads and operating conditions.